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TABLES OF QUEUE SIZE AND WAITING TIME DISTRIBUTIONS FOR M/M/C. --ETC(U)

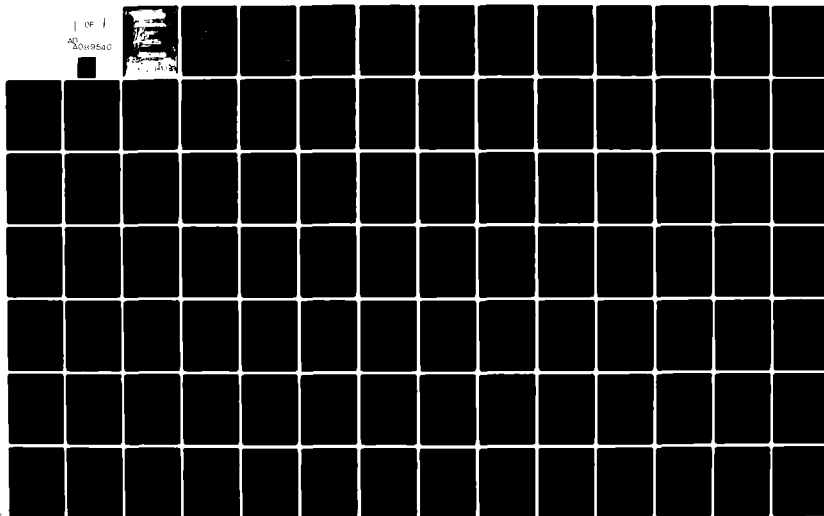
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TABLES OF QUEUE SIZE AND WAITING TIME DISTRIBUTIONS  
FOR M/M/c, M/D/c, AND D/M/c QUEUEING SYSTEMS

BY

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FOR THE OFFICE OF NAVAL RESEARCH

Frederick S. Hillier, Project Director

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Tables of Queue Size and Waiting Time Distributions  
for M/M/c, M/D/c, and D/M/c Queueing Systems

by

David M. Avis, Larry A. Edison, Lawrence D. Fossett,  
Frederick S. Hillier, Martin I. Reiman, and Oliver S. Yu

Abstract

This report provides a relatively comprehensive set of tables describing the steady-state behavior of M/M/c, M/D/c, and D/M/c queueing systems. The results given are the probability distribution of the number of customers in the system (including those being served) and of the waiting time of individual customers in the queue (excluding service time), as well as the expected number of customers in the queue (excluding those being served). The cases considered are  $c = 1, 2, \dots, 10$  and  $c = 15$  for all three classes of queueing systems, plus  $c = 12$  for M/D/c and  $c = 20, 25$  for M/M/c. For each case, the results are tabulated for 16 values of the traffic intensity ranging from 0.10 to 0.99. Also included for comparative purposes are the corresponding results for two related cases,  $D/E_2/2$  and  $M/E_2/2$ . These data represent one portion of the output from a large-scale project of theoretical research, algorithmic development, and computational effort to generate the obtainable numerical results for various classes of GI/G/c systems.

## 1. Introduction

This report provides a relatively comprehensive set of tables describing the steady-state behavior of certain basic types of queueing systems. The main types considered are those classes of GI/G/c systems involving the various combinations of exponential and degenerate (constant) distributions for the interarrival times and service times, namely,

M/M/c (Poisson input, exponential service times, c servers),

M/D/c (Poisson input, constant service times, c servers),

D/M/c (constant interarrival times, exponential service times, c servers).

Also included for comparative purposes are two related cases,  $D/E_2/2$  and  $M/E_2/2$ , where service times have an Erlang distribution whose shape parameter is 2.

The results given are the probability distribution of the number of customers in the system (including those being served) and of the waiting time of individual customers in the queue (excluding service time), as well as the expected number of customers in the queue (excluding those being served). The cases considered are  $c = 1, 2, \dots, 10$  and  $c = 15$  for all three classes of queueing systems, plus  $c = 12$  for M/D/c and  $c = 20, 25$  for M/M/c. For each case, the results are tabulated for 16 values of the traffic intensity ranging from 0.10 to 0.99.

These data represent one portion of the output from a large-scale project of theoretical research, algorithmic development, and computational effort to generate the obtainable numerical results for various classes of GI/G/c systems. Much of the project's output is to appear in a book, Queueing Theory and Graphs, by Hillier et al. (1981). However, space limitations prevented presenting all obtainable data there, so supplementary data are being given in the present report, as well as in a companion report by Avis et al. (1980) that considers  $E_m/M/c$ ,  $E_m/E_k/c$ , and  $E_m/D/c$  systems. In addition an earlier report by Hillier and Lo (1971) presented preliminary results from the project. For the sake of

completeness, there is some overlap between the tables in the book and in the present report (as well as the 1971 report). Furthermore, much of the tabulated data herein are summarized graphically in the book.

## 2. Notation

The following notation will be used hereafter:

$c$  = number of servers (parallel service channels)

$\lambda$  = mean arrival rate

$\mu$  = mean service rate per busy server

$\text{RHO} = \rho = \frac{\lambda}{c\mu}$  = traffic intensity

$N$  = number of customers in the system (including those being served) in steady state (a random variable)

STATE  $I$  = the condition of having  $N = I$

$P(N = I)$  = probability that  $N = I$

$P(N \leq I) = P(N \leq I)$

$WT$  = waiting time in the queue (excluding service time) of individual customers in steady state (a random variable)

$P(WT \leq T) = P(WT \leq T)$ , where the constant  $T$  is in units of expected service times

$L_q$  = steady-state expected number of customers in the queue (excluding those being served)

The tables of  $L_q$  are designated "Expected Length of Queue". Those of  $P(N \leq I)$  and  $P(WT \leq T)$  are labeled "CDF of Number in System" and "CDF of Waiting Time in the Queue", where CDF stands for "Cumulative Distribution Function".

## 3. Organization of Tables

The tables are organized into five sections according to the type of queueing system involved:  $M/M/c$ ,  $M/D/c$ ,  $D/M/c$ ,  $D/E_2/2$ ,  $M/E_2/2$ . Each section begins with a table of  $L_q$ , followed by a pair of tables for each value of  $c$  considered (in ascending order). One table in each pair gives  $P(N = I)$  and  $P(N \leq I)$ , whereas the other gives  $P(WT \leq T)$ .



#### 4. Reference for Additional Information

See Hillier et al. (1981) for additional information on the general nature of queueing systems (Sec. 1.1), the specific nature of the queueing systems studied here (Sec. 1.2), relationships between the results given here and other measures of performance (Sec. 1.5), and guidelines for interpolating or extrapolating on  $\rho$  or  $c$  (Sec. 1.6). This companion book also briefly summarizes the computational methods being used here (Sec. 1.7), and gives other references for the details of these methods.

#### REFERENCES

Avis, David M., Larry A. Edison, Lawrence D. Fossett, Frederick S. Hillier, Martin I. Reiman, and Oliver S. Yu (1980), "Tables of Queue Size Distribution for Queueing Systems with Erlang Interarrival Times," Technical Report No. 91 (ONR Contract N00014-76-C-0418) and Technical Report No. 58 (NSF Grant ENG75-14847), Dept. of Operations Research, Stanford University.

Hillier, Frederick S., and Frederick D. Lo (1971), "Tables for Multiple-Server Queueing Systems Involving Erlang Distributions," Technical Report No. 31 (ONR Contract N00014-67-A-0112-0058) and Technical Report No. 14 (NSF Grant GK-2925), Dept. of Operations Research, Stanford University.

Hillier, Frederick S., and Oliver S. Yu, with David M. Avis, Lawrence D. Fossett, Frederick D. Lo, and Martin I. Reiman (1981), Queueing Tables and Graphs, Elsevier North-Holland, New York.

### Tables for M/M/c Queueing Systems

**The Model:** Customers arrive randomly, i.e., according to a Poisson process  
(exponential distribution of interarrival times);  
service times have an exponential distribution;  
c servers operate in parallel.

**Notation:** See Section 1.2.

**Tables Included:**  $L_q$ ,  $P(N = 1)$  and  $P(N \leq 1)$ ,  $P(WT \leq T)$  for  $c = 1, 2, \dots$ ,  
10, 15, 20, 25.

EXPECTED LENGTH OF QUEUE FOR  $M/M/c$ 

c:	1	2	3	4	5
RHO					
0.10	0.11111E-01	0.20202E-02	0.41152E-03	0.88271E-04	0.19500E-04
0.20	0.50000E-01	0.16667E-01	0.61644E-02	0.23952E-02	0.95785E-03
0.30	0.12857E 00	0.59341E-01	0.30012E-01	0.15878E-01	0.86311E-02
0.40	0.26667E 00	0.15238E 00	0.94118E-01	0.60466E-01	0.39801E-01
0.50	0.50000E 00	0.33333E 00	0.23684E 00	0.17391E 00	0.13037E 00
0.55	0.67222E 00	0.47706E 00	0.35832E 00	0.27720E 00	0.21848E 00
0.60	0.90000E 00	0.67500E 00	0.53212E 00	0.43056E 00	0.35423E 00
0.65	0.12071E 01	0.95108E 00	0.78230E 00	0.65821E 00	0.56138E 00
0.70	0.16333E 01	0.13451E 01	0.11488E 01	0.10002E 01	0.88162E 00
0.75	0.22500E 01	0.19286E 01	0.17033E 01	0.15283E 01	0.13854E 01
0.80	0.32000E 01	0.28444E 01	0.25888E 01	0.23857E 01	0.22164E 01
0.85	0.48167E 01	0.44261E 01	0.41388E 01	0.39061E 01	0.37087E 01
0.90	0.81000E 01	0.76737E 01	0.73535E 01	0.70898E 01	0.68624E 01
0.95	0.18050E 02	0.17587E 02	0.17233E 02	0.16937E 02	0.15678E 02
0.98	0.48020E 02	0.47535E 02	0.47160E 02	0.46844E 02	0.46566E 02
0.99	0.98010E 02	0.97518E 02	0.97136E 02	0.96813E 02	0.96528E 02

c:	6	7	8	9	10
RHO					
0.10	0.43905E-05	0.10018E-05	0.23082E-06	0.53588E-07	0.12516E-07
0.20	0.39032E-03	0.16117E-03	0.67207E-04	0.28236E-04	0.11934E-04
0.30	0.47771E-02	0.26782E-02	0.15160E-02	0.86456E-03	0.49598E-03
0.40	0.26635E-01	0.18040E-01	0.12330E-01	0.84877E-02	0.58765E-02
0.50	0.99143E-01	0.76198E-01	0.59044E-01	0.46050E-01	0.36105E-01
0.55	0.17447E 00	0.14068E 00	0.11430E 00	0.93425E-01	0.76741E-01
0.60	0.29485E 00	0.24758E 00	0.20931E 00	0.17794E 00	0.15195E 00
0.65	0.48459E 00	0.42116E 00	0.36826E 00	0.32358E 00	0.28547E 00
0.70	0.78395E 00	0.70172E 00	0.63141E 00	0.57055E 00	0.51737E 00
0.75	0.12650E 01	0.11614E 01	0.10709E 01	0.99105E 00	0.91983E 00
0.80	0.20711E 01	0.19437E 01	0.18306E 01	0.17289E 01	0.16367E 01
0.85	0.35363E 01	0.33829E 01	0.32446E 01	0.31184E 01	0.30025E 01
0.90	0.66611E 01	0.64796E 01	0.63138E 01	0.61608E 01	0.60186E 01
0.95	0.16446E 02	0.16235E 02	0.16039E 02	0.15857E 02	0.15686E 02
0.98	0.46314E 02	0.46084E 02	0.45870E 02	0.45669E 02	0.45480E 02
0.99	0.96270E 02	0.96033E 02	0.95812E 02	0.95606E 02	0.95410E 02

c:	15	20	25
RHO			
0.10	0.92245E-11	0.72011E-14	0.58027E-17
0.20	0.17072E-06	0.25867E-08	0.40456E-10
0.30	0.32680E-04	0.22806E-05	0.16429E-06
0.40	0.99020E-03	0.17663E-03	0.32521E-04
0.50	0.11292E-01	0.37311E-02	0.12718E-02
0.55	0.30204E-01	0.12532E-01	0.53599E-02
0.60	0.72351E-01	0.36202E-01	0.18651E-01
0.65	0.15925E 00	0.92966E-01	0.55775E-01
0.70	0.32935E 00	0.21831E 00	0.14833E 00
0.75	0.65397E 00	0.48129E 00	0.36189E 00
0.80	0.12768E 01	0.10243E 01	0.83641E 00
0.85	0.25326E 01	0.21820E 01	0.19053E 01
0.90	0.54237E 01	0.49569E 01	0.45713E 01
0.95	0.14952E 02	0.14353E 02	0.13839E 02
0.98	0.44656E 02	0.43970E 02	0.43370E 02
0.99	0.94556E 02	0.93839E 02	0.93210E 02









ID	STATE 1				STATE 2				STATE 3			
	P(1-1)	P(1-2)	P(1-3)	P(1-4)	P(2-1)	P(2-2)	P(2-3)	P(2-4)	P(3-1)	P(3-2)	P(3-3)	P(3-4)
RHO = 10												
0.760781	0.760781	6	-33.3333E-05	0.999999	0.767444E-01	0.287476	18	-5.9948E-02	0.992010	5	-4.9948E-02	0.992010
2.222222	0.760781	7	-33.3333E-05	0.999999	1.166226	0.028748	19	-9.9961E-02	0.992010	1	-3.9961E-02	0.992010
2.333333E-01	0.999999	8	-33.3333E-05	1.000000	0.832222	0.028748	20	-1.9972E-02	0.999999	2	-1.9972E-02	0.999999
3.333333E-02	0.999999	9	-33.3333E-05	1.000000	1.161934	0.028748	21	-1.9972E-02	0.999999	3	-1.9972E-02	0.999999
3.333333E-03	0.999999	10	-33.3333E-05	1.000000	0.168545	0.040615	16	-1.9972E-02	0.999999	4	-1.9972E-02	0.999999
5.333333E-04	0.999999	11	-33.3333E-05	1.000000	5.788080E-01	0.760781	17	-1.2206E-02	0.995731	5	-1.2206E-02	0.995731
RHO = 20												
0.507958	0.507958	7	-21.5616E-04	0.999999	2.080780E-01	0.20151	20	-1.8669E-02	0.996797	5	-1.8669E-02	0.996797
1.370878	0.507958	8	-21.5616E-04	0.999999	7.460780E-01	0.20151	21	-1.8669E-02	0.996797	6	-1.8669E-02	0.996797
2.90610E-01	0.975162	9	-12.6287E-04	0.999999	3.36307E-01	0.899452	22	-4.6051E-03	0.996198	7	-4.6051E-03	0.996198
1.97220E-01	0.999999	10	-25.2493E-04	0.999999	1.166226	0.028748	23	-3.3770E-03	0.998985	8	-3.3770E-03	0.998985
5.00220E-02	0.999999	11	-50.8680E-04	0.999999	0.811934	0.028748	24	-1.9972E-03	0.991536	9	-1.9972E-03	0.991536
1.70000E-02	0.999999	12	-101.736E-04	0.999999	1.166226	0.028748	25	-1.9972E-03	0.991536	10	-1.9972E-03	0.991536
5.17000E-03	0.999999	13	-203.472E-04	0.999999	0.811934	0.028748	26	-1.9972E-03	0.991536	11	-1.9972E-03	0.991536
RHO = 30												
0.603634	0.603634	9	-11.9173E-03	0.999999	0.561798E-01	0.056180	18	-1.1188E-02	0.955525	18	-1.1188E-02	0.955525
3.361172	0.766570	9	-9.7357E-03	0.999999	1.139393	0.181931	19	-8.8949E-02	0.968420	19	-8.8949E-02	0.968420
1.363691	0.929471	10	-10.7207E-03	0.999999	1.161934	0.181931	20	-1.9972E-02	0.992728	20	-1.9972E-02	0.992728
4.33022E-01	0.978712	11	-25.2493E-03	0.999999	5.82940E-01	0.666198	21	-4.5522E-02	0.981788	21	-4.5522E-02	0.981788
4.16704E-01	0.995167	12	-50.8680E-03	0.999999	0.811934	0.028748	22	-3.3770E-03	0.998985	22	-3.3770E-03	0.998985
4.06112E-02	0.999999	13	-101.736E-03	0.999999	7.53071E-01	0.747474	23	-2.3375E-02	0.992572	23	-2.3375E-02	0.992572
6.13259E-02	0.999999	14	-203.472E-03	0.999999	0.426818E-01	0.019124	24	-1.0650E-02	0.992572	24	-1.0650E-02	0.992572
3.30703E-02	0.999999	15	-406.944E-03	0.999999	9.23911E-01	0.866276	25	-1.9972E-02	0.994030	25	-1.9972E-02	0.994030
RHO = 40												
0.2581												



[illegible]







[illegible]

[illegible]







[illegible]





## M/M/9 COF OF NUMBER IN SYSTEM

STATE	P(0-1)	P(0-2)	STATE	P(0-1)	P(0-2)	STATE	P(0-1)	P(0-2)	STATE	P(0-1)	P(0-2)	STATE	P(0-1)	P(0-2)
0	0.000000	0.000000	1	0.000000	0.000000	2	0.000000	0.000000	3	0.000000	0.000000	4	0.000000	0.000000
5	0.000000	0.000000	6	0.000000	0.000000	7	0.000000	0.000000	8	0.000000	0.000000	9	0.000000	0.000000
10	0.000000	0.000000	11	0.000000	0.000000	12	0.000000	0.000000	13	0.000000	0.000000	14	0.000000	0.000000
15	0.000000	0.000000	16	0.000000	0.000000	17	0.000000	0.000000	18	0.000000	0.000000	19	0.000000	0.000000
20	0.000000	0.000000	21	0.000000	0.000000	22	0.000000	0.000000	23	0.000000	0.000000	24	0.000000	0.000000
25	0.000000	0.000000	26	0.000000	0.000000	27	0.000000	0.000000	28	0.000000	0.000000	29	0.000000	0.000000
30	0.000000	0.000000	31	0.000000	0.000000	32	0.000000	0.000000	33	0.000000	0.000000	34	0.000000	0.000000
35	0.000000	0.000000	36	0.000000	0.000000	37	0.000000	0.000000	38	0.000000	0.000000	39	0.000000	0.000000
40	0.000000	0.000000	41	0.000000	0.000000	42	0.000000	0.000000	43	0.000000	0.000000	44	0.000000	0.000000
45	0.000000	0.000000	46	0.000000	0.000000	47	0.000000	0.000000	48	0.000000	0.000000	49	0.000000	0.000000
50	0.000000	0.000000	51	0.000000	0.000000	52	0.000000	0.000000	53	0.000000	0.000000	54	0.000000	0.000000
55	0.000000	0.000000	56	0.000000	0.000000	57	0.000000	0.000000	58	0.000000	0.000000	59	0.000000	0.000000
60	0.000000	0.000000	61	0.000000	0.000000	62	0.000000	0.000000	63	0.000000	0.000000	64	0.000000	0.000000
65	0.000000	0.000000	66	0.000000	0.000000	67	0.000000	0.000000	68	0.000000	0.000000	69	0.000000	0.000000
70	0.000000	0.000000	71	0.000000	0.000000	72	0.000000	0.000000	73	0.000000	0.000000	74	0.000000	0.000000
75	0.000000	0.000000	76	0.000000	0.000000	77	0.000000	0.000000	78	0.000000	0.000000	79	0.000000	0.000000
80	0.000000	0.000000	81	0.000000	0.000000	82	0.000000	0.000000	83	0.000000	0.000000	84	0.000000	0.000000
85	0.000000	0.000000	86	0.000000	0.000000	87	0.000000	0.000000	88	0.000000	0.000000	89	0.000000	0.000000
90	0.000000	0.000000	91	0.000000	0.000000	92	0.000000	0.000000	93	0.000000	0.000000	94	0.000000	0.000000
95	0.000000	0.000000	96	0.000000	0.000000	97	0.000000	0.000000	98	0.000000	0.000000	99	0.000000	0.000000

[illegible]

[illegible]

## M/M/10 COF OF WAITING TIME IN THE QUEUE

[illegible]





## M/M/15 CDF OF WAITING TIME IN THE QUEUE

TYPE	TIME	PERCENT	TYPE	TIME	PERCENT	TYPE	TIME	PERCENT	TYPE	TIME	PERCENT	TYPE	TIME	PERCENT
RHO=.10			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	
RHO=.20			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	
RHO=.30			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	
RHO=.40			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	
RHO=.50			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	
RHO=.60			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	
RHO=.70			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	
RHO=.80			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	
RHO=.90			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	
RHO=1.00			RHO=.05			RHO=.05			RHO=.05			RHO=.05		
G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000		G.C	1.000000	



M/M/20

### COF OF WAITING TIME IN THE QUEUE

[illegible]

STAGE 1				STAGE 2				STAGE 3				STAGE 4			
P (K=1)	P (K=2)	P (K=3)	P (K=4)	P (K=1)	P (K=2)	P (K=3)	P (K=4)	P (K=1)	P (K=2)	P (K=3)	P (K=4)	P (K=1)	P (K=2)	P (K=3)	P (K=4)
800-10															
0.820098-01	0.820295	4	-27.9337E-01	0.905813	0.699952E-01	0.000000	14	-53.2663E-01	0.155981	8	-5.1247E-11	0.009000	54	9.66117E-02	0.536301
0.285212	0.287297	7	-99.0802E-02	0.959753	1.319227E-04	0.000000	15	-66.6604E-01	0.275189	1	-1.25517E-09	0.009000	55	9.68061E-02	0.556406
2.250516	0.563813	8	-3.18064E-02	0.910805	2.323027E-05	0.000000	16	-70.054E-01	0.163285	2	-1.5517E-08	0.009000	60	8.72951E-02	0.572301
2.13282	0.157574	9	-0.157574E-01	0.909721	0.000000E-01	0.000000	17	-6.00000E-01	0.000000	3	-2.15456E-07	0.009000	61	8.74951E-02	0.569230
4.123642	0.001170	10	-21.5725E-03	0.909320	4.360612E-04	0.000000	18	-6.00000E-01	0.000000	4	-7.64900E-07	0.009000	66	8.76951E-02	0.570000
5.660009E-01	0.557979	11	-90.0250E-04	0.909107	5.135151E-03	0.000180	19	-6.00000E-01	0.000000	5	-3.76857E-06	0.000000	64	8.77210E-02	0.571100
					0.822259E-03	0.000001	20	-82.967E-01	0.054080	6	-1.53081E-05	0.000000	68	8.79259E-02	0.576120
					7.607133E-02	0.001736	21	-6.07133E-02	0.001736	7	-5.38569E-06	0.000000	70	8.81261E-02	0.580600
					0.265152E-02	0.004105	22	-6.31766E-01	0.787493	8	-1.644927E-06	0.000026	75	8.84663E-02	0.585300
					5.526681E-02	0.000195	23	-5.16468E-01	0.839616	9	-8.490000E-06	0.000005	80	8.87272E-02	0.591400
0.673795E-02	0.005738	7	-1.04445E-01	0.966628	1.039575E-01	0.002027	24	-2.002097E-01	0.879737	10	-1.100007E-01	0.000170	85	8.92078E-02	0.597100
0.980978E-01	0.004028	8	-6.657370E-01	0.913066	1.764508E-01	0.017720	25	-3.015733E-01	0.909528	11	-2.001724E-01	0.000170	90	8.95126E-02	0.602800
3.140274	0.265306	10	-1.01322E-01	0.906360	12.759578E-01	0.055506	26	-2.261610E-01	0.932166	12	-5.002490E-01	0.000024	95	8.98172E-02	0.608500
0.175667	0.044933	11	-8.02181E-02	0.909506	13.397877E-01	0.104295	27	-3.715640E-02	0.970530	13	-9.42759E-01	0.000167	100	8.99303E-02	0.613200
5.179667	0.615660	12	-3.06324E-02	0.997901						14	-1.649830E-02	0.000157	105	9.01565E-02	0.617700
0.166233	0.762193	13	-13.0066E-02	0.999301						15	-2.69972E-02	0.000157	110	9.03827E-02	0.622200
										16	-1.62629E-02	0.000138	115	9.06172E-02	0.626700
										17	-5.96671E-02	0.016280	120	9.08527E-02	0.631200
										18	-8.09914E-02	0.026070	125	9.10878E-02	0.635700
										19	-1.100007E-01	0.034816	130		

[illegible]

## Tables for M/D/c Queueing Systems

The Model: Customers arrive randomly, i.e., according to a Poisson process  
(exponential distribution of interarrival times);  
service times are constant;  
c servers operate in parallel.

Notation: See Section 1.2.

Tables Included:  $L_q$ ,  $P(N = I)$  and  $P(N \leq I)$ ,  $P(WT \leq T)$  for  $c = 1, 2, \dots$ ,  
10, 12, 15.

## EXPECTED LENGTH OF QUEUE FOR M/D/c

c:	1	2	3	4
RHO				
0.10	0.55556E-02	0.12417E-02	0.28421E-03	0.65625E-04
0.20	0.25000E-01	0.96911E-02	0.39499E-02	0.15461E-02
0.30	0.64286E-01	0.33156E-01	0.18085E-01	0.10147E-01
0.40	0.13333E 00	0.82649E-01	0.54013E-01	0.36318E-01
0.50	0.25000E 00	0.17674E 00	0.13080E 00	0.99303E-01
0.55	0.33611E 00	0.25059E 00	0.19475E 00	0.15493E 00
0.60	0.45000E 00	0.35164E 00	0.28514E 00	0.23610E 00
0.65	0.60357E 00	0.49184E 00	0.41395E 00	0.35486E 00
0.70	0.81667E 00	0.69105E 00	0.60112E 00	0.53118E 00
0.75	0.11250E 01	0.98504E 00	0.88242E 00	0.80088E 00
0.80	0.16000E 01	0.14453E 01	0.13294E 01	0.12355E 01
0.85	0.24083E 01	0.22384E 01	0.21087E 01	0.20018E 01
0.90	0.40500E 01	0.38645E 01	0.37204E 01	0.35999E 01
0.95	0.90250E 01	0.88235E 01	0.86645E 01	0.85298E 01
0.98	0.24010E 02	0.23799E 02	0.23631E 02	0.23487E 02
0.99	0.49005E 02	0.48790E 02	0.48619E 02	0.48473E 02
c:	5	6	7	8
RHO				
0.10	0.15239E-04	0.35555E-05	0.83312E-06	0.19596E-06
0.20	0.69393E-03	0.29452E-03	0.12558E-03	0.53729E-04
0.30	0.57857E-02	0.33321E-02	0.19317E-02	0.11250E-02
0.40	0.24851E-01	0.17204E-01	0.12007E-01	0.84297E-02
0.50	0.76633E-01	0.59814E-01	0.47076E-01	0.37284E-01
0.55	0.12513E 00	0.10215E 00	0.84061E-01	0.69596E-01
0.60	0.19820E 00	0.16803E 00	0.14350E 00	0.12325E 00
0.65	0.30793E 00	0.26954E 00	0.23750E 00	0.21036E 00
0.70	0.47431E 00	0.42673E 00	0.38614E 00	0.35101E 00
0.75	0.73322E 00	0.67552E 00	0.62536E 00	0.58116E 00
0.80	0.11562E 01	0.10875E 01	0.10268E 01	0.97250E 00
0.85	0.19102E 01	0.18296E 01	0.17574E 01	0.16920E 01
0.90	0.34951E 01	0.34018E 01	0.33173E 01	0.32398E 01
0.95	0.84112E 01	0.83045E 01	0.82067E 01	0.81163E 01
0.98	0.23360E 02	0.23245E 02	0.23139E 02	0.23040E 02
0.99	0.48343E 02	0.48225E 02	0.48116E 02	0.48014E 02
c:	9	10	12	15
RHO				
0.10	0.46250E-07	0.10948E-07	0.61804E-09	0.84122E-11
0.20	0.23053E-04	0.99151E-05	0.18452E-05	0.14996E-06
0.30	0.65735E-03	0.38509E-03	0.13292E-03	0.27241E-04
0.40	0.59439E-02	0.42052E-02	0.21202E-02	0.76831E-03
0.50	0.29674E-01	0.23709E-01	0.15269E-01	0.80131E-02
0.55	0.57900E-01	0.48358E-01	0.34039E-01	0.20429E-01
0.60	0.10635E 00	0.92114E-01	0.69718E-01	0.46658E-01
0.65	0.13711E 00	0.16701E 00	0.13416E 00	0.98108E-01
0.70	0.32026E 00	0.29310E 00	0.24734E 00	0.19448E 00
0.75	0.54178E 00	0.50639E 00	0.44524E 00	0.37160E 00
0.80	0.92339E 00	0.87862E 00	0.79963E 00	0.70123E 00
0.85	0.16321E 01	0.15768E 01	0.14776E 01	0.13505E 01
0.90	0.31681E 01	0.31012E 01	0.29795E 01	0.28198E 01
0.95	0.80318E 01	0.79523E 01	0.78057E 01	0.76099E 01
0.98	0.22947E 02	0.22860E 02	0.22697E 02	0.22478E 02
0.99	0.47919E 02	0.47829E 02	0.47661E 02	0.47433E 02

[illegible]







[illegible]

STATE 1				STATE 2				STATE 3				STATE 4				STATE 5			
PIN-11	PINC-11	PIN-11	PINC-11	PIN-11	PINC-11	PIN-11	PINC-11	PIN-11	PINC-11	PIN-11	PINC-11	PIN-11	PINC-11	PIN-11	PINC-11	PIN-11	PINC-11		
RHO=.10				RHO=.70				RHO=.90				RHO=.95				RHO=.99			
0 .740620	0 .740620	6 .741382E-06	1.000000	0 .879087E-01	0 .088700	14 .179723E-03	0 .999814	0 .978961E-02	0 .009784	24 .100105E-01	0 .908909	0 .740620	0 .740620	6 .741382E-06	1.000000	0 .879087E-01	0 .088700		
1 .232322	0 .862992	7 .329056E-07	1.000000	1 .230228	0 .288174	15 .191398E-03	0 .999905	1 .322138E-01	0 .041999	25 .958423E-02	0 .918493	1 .232322	0 .862992	7 .329056E-07	1.000000	1 .230228	0 .288174		
2 .333950E-01	0 .996187	8 .125016E-07	1.000000	2 .751515	0 .521915	16 .186130E-03	0 .999952	2 .562155E-01	0 .038215	26 .665733E-02	0 .919150	2 .333950E-01	0 .996187	8 .125016E-07	1.000000	2 .751515	0 .521915		
3 .335101E-01	0 .997333	9 .425342E-07	1.000000	3 .193647	0 .711877	17 .236295E-04	0 .999976	3 .193647E-01	0 .031547	27 .781606E-02	0 .926970	3 .335101E-01	0 .997333	9 .425342E-07	1.000000	3 .193647	0 .711877		
4 .251490E-01	0 .999984	10 .131797E-07	1.000000	4 .127878	0 .845155	18 .120254E-04	0 .999988	4 .247672E-01	0 .024918	28 .700354E-02	0 .934033	4 .251490E-01	0 .999984	10 .131797E-07	1.000000	4 .127878	0 .845155		
5 .151456E-01	0 .999999	11 .376274E-07	1.000000	5 .736153E-01	0 .919374	19 .611995E-05	0 .999994	5 .717007E-01	0 .015647	29 .160346E-02	0 .940433	5 .151456E-01	0 .999999	11 .376274E-07	1.000000	5 .736153E-01	0 .919374		
RHO=.20				RHO=.75				RHO=.95				RHO=.99				RHO=.99			
0 .546899	0 .546899	8 .282959E-06	1.000000	9 .525523E-07	0 .995558	23 .103510E-04	1.000000	9 .480333E-01	0 .544268	33 .624747E-02	0 .964033	0 .546899	0 .546899	8 .282959E-06	1.000000	9 .525523E-07	0 .995558		
1 .329822	0 .878721	9 .112107E-07	1.000000	10 .267291E-07	0 .997230	24 .208919E-04	1.000000	10 .440759E-01	0 .568168	34 .186369E-02	0 .964170	1 .329822	0 .878721	9 .112107E-07	1.000000	10 .267291E-07	0 .997230		
2 .966170E-01	0 .976139	1 .149211E-06	1.000000	11 .134007E-02	0 .999587	25 .104222E-04	1.000000	11 .390155E-01	0 .628163	35 .366556E-02	0 .970765	2 .966170E-01	0 .976139	1 .149211E-06	1.000000	11 .134007E-02	0 .999587		
3 .201366E-01	0 .996516	11 .102762E-07	1.000000	12 .49212E-03	0 .999283	26 .541092E-07	1.000000	12 .708164E-01	0 .696154	36 .515017E-02	0 .976396	3 .201366E-01	0 .996516	11 .102762E-07	1.000000	12 .49212E-03	0 .999283		
4 .306569E-02	0 .999581	12 .702157E-11	1.000000	13 .522264E-03	0 .999635	27 .215311E-07	1.000000	13 .390155E-01	0 .668428	37 .515017E-02	0 .976396	4 .306569E-02	0 .999581	12 .702157E-11	1.000000	13 .522264E-03	0 .999635		
5 .734093E-01	0 .999937	13 .483142E-12	1.000000	14 .66163E-03	0 .999937	28 .332805E-06	1.000000	14 .324731E-01	0 .729598	38 .255411E-02	0 .976474	5 .734093E-01	0 .999937	13 .483142E-12	1.000000	14 .66163E-03	0 .999937		
6 .388622E-26	0 .999996	14 .331692E-13	1.790000	15 .234912E-14	1.000000	29 .176264E-01	0 .786032	15 .260508E-01	0 .752464	39 .232707E-02	0 .976474	6 .388622E-26	0 .999996	14 .331692E-13	1.790000	15 .234912E-14	1.000000		
7 .350047E-05	0 .999999	15 .234912E-14	1.000000	0 .476057E-01	0 .047599	16 .122214E-03	0 .999964	17 .219921E-01	0 .778406	40 .208337E-02	0 .980538	7 .350047E-05	0 .999999	15 .234912E-14	1.000000	0 .476057E-01	0 .047599		
RHO=.30				RHO=.80				RHO=.95				RHO=.99				RHO=.99			
0 .400540	0 .400540	9 .945780E-06	1.000000	1 .164705	0 .234335	17 .122872E-03	0 .999829	18 .176264E-01	0 .786032	41 .208337E-02	0 .980538	0 .400540	0 .400540	9 .945780E-06	1.000000	1 .164705	0 .234335		
1 .365400	1 .365400	10 .119043E-06	1.000000	2 .213782	0 .448116	18 .741368E-04	0 .999909	19 .195164E-01	0 .817561	42 .170030E-02	0 .986121	1 .365400	1 .365400	10 .119043E-06	1.000000	2 .213782	0 .448116		
2 .935178	0 .935178	11 .149833E-07	1.000000	3 .192771	0 .640888	19 .427657E-04	0 .999942	20 .195164E-01	0 .817561	43 .155935E-02	0 .985477	2 .935178	0 .935178	11 .149833E-07	1.000000	3 .192771	0 .640888		
3 .51618E-01	0 .985171	12 .188771E-08	1.000000	4 .140414	0 .781107	20 .242887E-04	0 .999968	21 .195164E-01	0 .817561	44 .138750E-02	0 .984044	3 .51618E-01	0 .985171	12 .188771E-08	1.000000	4 .140414	0 .781107		
4 .120891E-01	0 .997297	13 .238426E-09	1.000000	5 .901163E-01	0 .871414	21 .192927E-04	0 .999981	22 .195164E-01	0 .817561	45 .125312E-02	0 .982977	4 .120891E-01	0 .997297	13 .238426E-09	1.000000	5 .901163E-01	0 .871414		
5 .230408E-02	0 .999561	14 .302212E-10	1.000000	6 .540774E-01	0 .925501	22 .082062E-04	0 .999994	23 .195164E-01	0 .817561	46 .113191E-02	0 .982029	5 .230408E-02	0 .999561	14 .302212E-10	1.000000	6 .540774E-01	0 .925501		
6 .376105E-03	0 .999937	15 .385472E-11	1.000000	7 .315173E-01	0 .957010	23 .473117E-05	0 .999994	24 .195164E-01	0 .817561	47 .102742E-02	0 .981057	6 .376105E-03	0 .999937	15 .385472E-11	1.000000	7 .315173E-01	0 .957010		
7 .97392E-04	0 .999999	16 .490836E-11	1.000000	8 .181978E-01	0 .975216	24 .273118E-05	0 .999994	25 .195164E-01	0 .817561	48 .916396E-02	0 .979756	7 .97392E-04	0 .999999	16 .490836E-11	1.000000	8 .181978E-01	0 .975216		
8 .736462E-05	0 .999999	17 .651578E-13	1.000000	9 .104903E-01	0 .989737	25 .195164E-05	0 .999999	26 .195164E-01	0 .817561	49 .809499E-02	0 .978756	8 .736462E-05	0 .999999	17 .651578E-13	1.000000	9 .104903E-01	0 .989737		
RHO=.40				RHO=.85				RHO=.95				RHO=.99				RHO=.99			
0 .288977	0 .288977	11 .624095E-06	1.000000	10 .819780E-01	0 .995135	26 .980486E-06	0 .999999	27 .195164E-01	0 .817561	50 .709499E-02	0 .977756	0 .288977	0 .288977	11 .624095E-06	1.000000	10 .819780E-01	0 .995135		
1 .335984	0 .846873	12 .126491E-06	1.000000	11 .328951E-01	0 .997230	27 .195164E-06	0 .999999	28 .195164E-01	0 .817561	51 .609499E-02	0 .976756	1 .335984	0 .846873	12 .126491E-06	1.000000	11 .328951E-01	0 .997230		
2 .221378	0 .886201	13 .245796E-07	1.000000	12 .184757E-01	0 .999587	28 .195164E-06	0 .999999	29 .195164E-01	0 .817561	52 .519499E-02	0 .975756	2 .221378	0 .886201	13 .245796E-07	1.000000	12 .184757E-01	0 .999587		
3 .935178	0 .935178	14 .365400E-07	1.000000	13 .184953	0 .549411	29 .195164E-06	0 .999999	30 .195164E-01	0 .817561	53 .429499E-02	0 .974756	3 .935178	0 .935178	14 .365400E-07	1.000000	13 .184953	0 .549411		
4 .101779E-01	0 .985171	15 .193454E-08	1.000000	14 .145964	0 .695337	30 .195164E-06	0 .999999	31 .195164E-01	0 .817561	54 .339499E-02	0 .973756	4 .101779E-01	0 .985171	15 .193454E-08	1.000000	14 .145964	0 .695337		
5 .809524E-02	0 .997616	16 .191347E-09	1.000000	15 .104034	0 .799391	31 .195164E-06	0 .999999	32 .195164E-01	0 .817561	55 .249499E-02	0 .972756	5 .809524E-02	0 .997616	16 .191347E-09	1.000000	15 .104034	0 .799391		
6 .188061E-02	0 .999697	17 .371927E-10	1.000000	16 .698571E-01	0 .869243	32 .195164E-06	0 .999999	33 .195164E-01	0 .817561	56 .159499E-02	0 .971756	6 .188061E-02	0 .999697	17 .371927E-10	1.000000	16 .698571E-01	0 .869243		
7 .401941E-03	0 .999989	18 .251173E-11	1.000000	17 .457635E-01	0 .915070	33 .195164E-06	0 .999999	34 .195164E-01	0 .817561	57 .069499E-02	0 .970756	7 .401941E-03	0 .999989	18 .251173E-11	1.000000	17 .457635E-01	0 .915070		
8 .01408E-04	0 .999999	19 .289802E-12	1.000000	18 .296768E-01	0 .949818	34 .195164E-06	0 .999999	35 .195164E-01	0 .817561	58 .009499E-02	0 .969756	8 .01408E-04	0 .999999	19 .289802E-12	1.000000	18 .296768E-01	0 .949818		
9 .181241E-04	0 .999999	20 .294968E-12	1.000000	19 .160691E-01	0 .974087	35 .195164E-06	0 .999999	36 .195164E-01	0 .817561	59 .009499E-02	0 .968756	9 .181241E-04	0 .999999	20 .294968E-12	1.000000	19 .160691E-01	0 .974087		
10 .317712E-04	0 .999999	21 .594304E-13	1.000000	20 .819314E-01	0 .976671	36 .195164E-06	0 .999999	37 .195164E-01	0 .817561	60 .009499E-02	0 .967756	10 .317712E-04	0 .999999	21 .594304E-13	1.000000	20 .819314E-01	0 .976671		
RHO=.50				RHO=.90				RHO=.95				RHO=.99				RHO=.99			
0 .203523	0 .203523	12 .363533E-05	0 .999999	0 .498414E-01	0 .049841	19 .250086E-03	0 .999517	0 .183595E-01	0 .237256	61 .009499E-02	0 .966756	0 .203523	0 .203523	12 .363533E-05	0 .999999	0 .498414E-01	0 .049841		
1 .131822	0 .521750	13 .103500E-05	1.000000	1 .132859	0 .182701	20 .169046E-03	0 .999686	1 .301777E-01	0 .267361	62 .009499E-02	0 .965756	1 .131822	0 .521750	13 .103500E-05	1.000000	1 .132859	0 .182701		
2 .252977	1 .774727	14 .296476E-06	1.000000	2 .181493	0 .549411	21 .741128E-04	0 .999867	2 .289136E-01	0 .296281	63 .009499E-02	0 .964756	2 .252977	1 .774727	14 .296476E-06	1.000000	2 .181493	0 .549411		
3 .137604	0 .812127	15 .838877E-07	1.000000	3 .145964	0 .695337	22 .461128E-04	0 .999914	3 .177599E-01	0 .326957	64 .009499E-02	0 .963756	3 .137604	0 .812127	15 .838877E-07	1.000000	3 .145964	0 .695337		
4 .597000E-01	0 .707133	16 .238802E-07	1.000000	4 .698571E-01	0 .869243	23 .196022E-04	0 .999984	4 .268151E-01	0 .350736	65 .009499E-02	0 .962756	4 .597000E-01	0 .707133	16 .238802E-07	1.000000	4 .698571E-01	0 .869243		
5 .26111E-01	0 .900744	17 .679788E-08	1.000000	5 .976768E-01	0 .949818	24 .196022E-04	0 .999984	5 .350736E-01	0 .373631	66 .009499E-02	0 .961756	5 .26111E-01	0 .900744	17 .679788E-08	1.000000	5 .976768E-01	0 .949818		
6 .453830E-02	0 .997282	18 .193511E-08	1.000000	6 .193141E-01	0 .976671	25 .196022E-04	0 .999984	6 .440759E-01	0 .390078	67 .009499E-02	0 .960756	6 .453830E-02	0 .997282	18 .193511E-08	1.000000	6 .193141E-01	0 .976671		
7 .193897E-03	0 .999222	19 .950806E-09	1.000000	7 .123645E-01	0 .976671	26 .196022E-04	0 .999984	7 .530736E-01	0 .409099	68 .009499E-02	0 .959756	7 .193897E-03	0 .999222	19 .950806E-09	1.000000	7 .123645E-01	0 .976671		
8 .557183E-03	0 .999770	20 .156819E-09	1.000000	8 .103571E-01	0 .995135	27 .196022E-04	0 .999984	8 .620736E-01	0 .428125	69 .009499E-02	0 .958756	8 .557183E-03	0 .999770	20 .156819E-09	1.000000	8 .103571E-01	0 .995135		
9 .198309E-03	0 .999937	21 .466022E-10	1.0																

## M/D/3 CDF OF WAITING TIME IN THE QUEUE

TIME T	P(WT<T)	TIME T	P(WT<T)	TIME T	P(WT<T)	TIME T	P(WT<T)	TIME T	P(WT<T)	TIME T	P(WT<T)
BRO= .10				BRO= .55				BRO= .75			
0.0	0.999307	0.5	0.999992	0.0	0.720252	1.2	0.991000	0.0	0.440116	1.5	0.943070
0.1	0.997306	0.6	0.999733	0.1	0.762020	1.3	0.993530	0.1	0.497299	1.6	0.952085
0.2	0.996000	0.7	0.999603	0.2	0.802933	1.4	0.995375	0.2	0.540133	1.7	0.959362
0.3	0.995072	0.8	0.999504	0.3	0.840909	1.5	0.996693	0.3	0.590676	1.8	0.965520
0.4	0.994313	0.9	0.999404	0.4	0.875692	1.6	0.997627	0.4	0.630700	1.9	0.970766
BRO= .20				0.5	0.906293	1.7	0.998290	0.5	0.690936	2.0	0.975210
0.0	0.976379	0.8	0.999632	0.6	0.932020	1.8	0.998765	0.6	0.745713	2.5	0.989104
0.1	0.981000	0.9	0.999906	0.7	0.952393	1.9	0.999109	0.7	0.790500	3.0	0.995200
0.2	0.986000	1.0	0.999957	0.8	0.967263	2.0	0.999359	0.8	0.821202	3.5	0.997016
0.3	0.990013	1.1	0.999976	0.9	0.977001	2.5	0.999976	0.9	0.849174	4.0	0.999087
0.4	0.993757	1.2	0.999987	1.0	0.983190	3.0	0.999976	1.0	0.871623	4.5	0.999600
0.5	0.996100	1.3	0.999993	1.1	0.987621	3.5	0.999995	1.1	0.890033	5.0	0.999825
0.6	0.997802	1.4	0.999997	BRO= .60				1.2	0.906049	6.0	0.999966
0.7	0.998000	1.5	0.999999	0.0	0.660170	1.3	0.993250	1.3	0.921174	7.0	0.999990
BRO= .30				0.1	0.706451	1.4	0.994047	1.4	0.932757	8.0	0.999999
0.0	0.633519	1.1	0.999732	0.2	0.751719	1.5	0.994820	BRO= .80			
0.1	0.647701	1.2	0.999844	0.3	0.795030	1.6	0.995620	0.0	0.367650	1.6	0.907833
0.2	0.660330	1.3	0.999913	0.4	0.837262	1.7	0.996407	0.1	0.413211	1.7	0.910600
0.3	0.671090	1.4	0.999954	0.5	0.877737	1.8	0.997043	0.2	0.461390	1.8	0.920004
0.4	0.680010	1.5	0.999976	0.6	0.903093	1.9	0.997696	0.3	0.511209	1.9	0.937107
0.5	0.687090	1.6	0.999988	0.7	0.928074	2.0	0.998267	0.4	0.561508	2.0	0.946771
0.6	0.692301	1.7	0.999994	0.8	0.948093	2.5	0.999502	0.5	0.611202	2.5	0.971063
0.7	0.696000	1.8	0.999996	0.9	0.961600	3.0	0.999976	0.6	0.650615	3.0	0.980837
0.8	0.698170	1.9	0.999998	1.0	0.970715	3.5	0.999976	0.7	0.702119	3.5	0.992055
0.9	0.699200	2.0	0.999999	1.1	0.977600	4.0	0.999996	0.8	0.740306	4.0	0.995837
1.0	0.699501			1.2	0.983001	4.5	0.999999	0.9	0.772507	4.5	0.997010
BRO= .40				BRO= .65				1.0	0.799391	5.0	0.998057
0.0	0.666201	1.1	0.999035	0.0	0.596663	1.4	0.993005	1.1	0.823102	6.0	0.999006
0.1	0.691700	1.2	0.999004	0.1	0.643731	1.5	0.993190	1.2	0.844051	7.0	0.999710
0.2	0.715001	1.3	0.999027	0.2	0.692609	1.6	0.993390	1.3	0.861371	8.0	0.999761
0.3	0.735003	1.4	0.999026	0.3	0.740207	1.7	0.993601	1.4	0.880037	9.0	0.999904
0.4	0.753000	1.5	0.999075	0.4	0.789517	1.8	0.993833	1.5	0.896406		
0.5	0.768131	1.6	0.999084	0.5	0.827366	1.9	0.994071	1.6	0.911500		
0.6	0.779017	1.7	0.999094	0.6	0.864303	2.0	0.994303	1.7	0.926150		
0.7	0.787931	1.8	0.999100	0.7	0.899357	2.5	0.994605	1.8	0.941094		
0.8	0.793109	1.9	0.999100	0.8	0.931050	3.0	0.994909	1.9	0.956022		
0.9	0.796251	2.0	0.999100	0.9	0.957050	3.5	0.995083	2.0	0.970826		
1.0	0.797616	2.5	0.999100	1.0	0.980696	4.0	0.995265	2.5	0.985000		
BRO= .50				1.1	0.998006	4.5	0.995407	3.0	0.998057		
0.0	0.770727	1.2	0.999033	1.2	0.998160	5.0	0.995507	3.5	0.998217		
0.1	0.811116	1.3	0.999047	1.3	0.975827			4.0	0.998394		
0.2	0.840000	1.4	0.999049	BRO= .70				4.5	0.998500		
0.3	0.870111	1.5	0.999053	0.0	0.523915	1.4	0.963007	5.0	0.998610		
0.4	0.897002	1.6	0.999052	0.1	0.570075	1.5	0.970500	5.5	0.998725		
0.5	0.922007	1.7	0.999052	0.2	0.620079	1.6	0.975570	6.0	0.998800		
0.6	0.932009	1.8	0.999052	0.3	0.670082	1.7	0.980375	6.5	0.998860		
0.7	0.940075	1.9	0.999052	0.4	0.720081	1.8	0.985062	7.0	0.998900		
0.8	0.946075	2.0	0.999070	0.5	0.770084	1.9	0.989600	7.5	0.998930		
0.9	0.950075	2.5	0.999067	0.6	0.820080	2.0	0.993002	8.0	0.998950		
1.0	0.950070	3.0	0.999065	0.7	0.870080	2.5	0.996100	8.5	0.998960		
1.1	0.950010			0.8	0.920080	3.0	0.999000	9.0	0.998970		
				0.9	0.970080	3.5	0.999000	9.5	0.998980		
				1.0	0.990080	4.0	0.999000	10.0	0.998990		
				1.1	0.993080	4.5	0.999000				
				1.2	0.995080	5.0	0.999000				
				1.3	0.996080	5.5	0.999000				
				1.4	0.997080	6.0	0.999000				



TIME T		TIME T		TIME T		TIME T		TIME T		TIME T		TIME T		TIME T		TIME T	
P (P(TC<T))		P (P(TC<T))		P (P(TC<T))		P (P(TC<T))		P (P(TC<T))		P (P(TC<T))		P (P(TC<T))		P (P(TC<T))		P (P(TC<T))	
BDO= .10																	
0.0	0.999223	0.5	0.999943	0.0	0.706410	1.1	0.996192	0.0	0.500963	1.4	0.971529	0.0	0.220563	1.4	0.770306	0.0	0.770306
0.1	0.999670	0.6	0.999976	0.0	0.820008	1.2	0.997206	0.1	0.560030	1.5	0.977159	0.1	0.260002	1.7	0.795977	0.1	0.795977
0.2	0.999661	0.7	0.999992	0.2	0.867070	1.3	0.998071	0.2	0.627627	1.6	0.981635	0.2	0.308912	1.9	0.872217	0.2	0.872217
0.1	0.999795	0.8	0.999999	0.3	0.901021	1.4	0.999109	0.3	0.695212	1.7	0.987053	0.3	0.352336	2.0	0.927155	0.3	0.927155
0.0	0.999900			0.4	0.920995	1.5	0.999653	0.4	0.739915	1.8	0.988107	0.4	0.399120	2.0	0.968006	0.4	0.968006
				0.5	0.932770	1.6	0.999677	0.5	0.789930	1.9	0.990522	0.5	0.405025	2.5	0.990000	0.5	0.990000
				0.6	0.946768	1.7	0.999732	0.6	0.831020	2.0	0.992395	0.6	0.400030	3.0	0.990525	0.6	0.990525
				0.7	0.961000	1.8	0.999815	0.7	0.866006	2.5	0.997053	0.7	0.532701	3.5	0.990001	0.7	0.990001
				0.8	0.980532	1.9	0.999905	0.8	0.890150	3.0	0.999158	0.8	0.570662	4.0	0.990662	0.8	0.990662
				0.9	0.992667	2.0	0.999929	0.9	0.909929	3.5	0.999720	0.9	0.600050	4.5	0.990550	0.9	0.990550
				1.0	0.995110	2.5	0.999993	1.0	0.921202	4.0	0.999907	1.0	0.635657	5.0	0.990533	1.0	0.990533
								1.1	0.930070	4.5	0.999909	1.1	0.660000	6.0	0.990215	1.1	0.990215
								1.2	0.935605	5.0	0.999910	1.2	0.697196	7.0	0.990706	1.2	0.990706
								1.3	0.940005	6.0	0.999911	1.3	0.710113	8.0	0.990897	1.3	0.990897
												1.4	0.730000	9.0	0.990918	1.4	0.990918
												1.5	0.750251	10.0	0.990970	1.5	0.990970
BDO= .55																	
0.0	0.999223	0.5	0.999943	0.0	0.720336	1.2	0.995022	0.0	0.421710	1.5	0.968204	0.0	0.115600	6.0	0.960100	0.0	0.960100
0.1	0.999670	0.6	0.999976	0.1	0.773390	1.3	0.996753	0.1	0.470737	1.6	0.973395	0.1	0.160000	7.0	0.960000	0.1	0.960000
0.2	0.999661	0.7	0.999992	0.2	0.823223	1.4	0.997791	0.2	0.510000	1.7	0.977912	0.2	0.200000	8.0	0.960000	0.2	0.960000
0.1	0.999795	0.8	0.999999	0.3	0.860429	1.5	0.998091	0.3	0.550112	1.8	0.980000	0.3	0.250000	9.0	0.960000	0.3	0.960000
0.0	0.999900			0.4	0.900092	1.6	0.998606	0.4	0.590112	1.9	0.983992	0.4	0.300000	10.0	0.960000	0.4	0.960000
				0.5	0.930000	1.7	0.999000	0.5	0.630000	2.0	0.987000	0.5	0				

[illegible]



TIME T	P (UTC-T)	TIME T	P (UTC-T)
SUN-10			
0.0	0.999020	0.0	0.999000
0.1	0.999004	0.5	0.999001
0.2	0.999029	0.0	0.999000
0.1	0.999007		
SUN-10			
0.0	0.999320	0.5	0.999025
0.1	0.999043	0.0	0.999027
0.2	0.999070	0.7	0.999023
0.1	0.999037	0.0	0.999007
0.0	0.999001		
SUN-10			
0.0	0.999020	0.0	0.999002
0.1	0.999007	0.7	0.999000
0.2	0.999000	0.0	0.999004
0.3	0.999020	0.9	0.999000
0.4	0.999010	1.0	0.999005
0.5	0.999037	1.1	0.999000
SUN-10			
0.0	0.999000	0.0	0.999002
0.1	0.999012	0.0	0.999000
0.2	0.999010	0.0	0.999000
0.3	0.999017	1.1	0.999000
0.4	0.999025	1.2	0.999000
0.5	0.999015	1.3	0.999000
0.6	0.999025	1.0	0.999000
0.7	0.999033	1.5	0.999000
SUN-10			
0.0	0.999050	1.1	0.999000
0.1	0.999025	1.2	0.999000
0.2	0.999000	1.3	0.999000
0.1	0.999010	1.0	0.999055
0.2	0.999017	1.5	0.999000
0.3	0.999033	0.0	0.999007
0.4	0.999000	1.7	0.999000
0.5	0.999027	1.0	0.999000
0.6	0.999010	1.9	0.999000
0.7	0.999000	2.0	0.999000
0.0	0.999037		

TIME T	P (W-C-T)	TIME T	P (W-C-T)
RHO= .55			
0.0	0.033267	1.1	0.999155
0.1	0.037878	1.2	0.999116
0.2	0.037535	1.3	0.999122
0.3	0.037515	1.4	0.999106
0.4	0.950702	1.5	0.999060
0.5	0.975001	1.6	0.999106
0.6	0.980312	1.7	0.999060
0.7	0.982588	1.8	0.999062
0.8	0.985073	1.9	0.999090
0.9	0.997588	2.0	0.999194
1.0	0.999555		
RHO= .60			
0.0	0.070001	1.1	0.997017
0.1	0.020004	1.2	0.996093
0.2	0.071005	1.3	0.999161
0.3	0.980000	1.4	0.999079
0.4	0.980378	1.5	0.999076
0.5	0.980320	1.6	0.999108
0.6	0.979002	1.7	0.999079
0.7	0.978568	1.8	0.999121
0.8	0.997108	1.9	0.999151
0.9	0.998520	2.0	0.999070
1.0	0.998516	2.5	0.999157
RHO= .65			
0.0	0.115125	1.2	0.996038
0.1	0.177209	1.3	0.997638
0.2	0.280000	1.4	0.998020
0.3	0.469793	1.5	0.999048
0.4	0.707000	1.6	0.999250
0.5	0.937617	1.7	0.999120
0.6	0.980956	1.8	0.999025
0.7	0.977695	1.9	0.999100
0.8	0.982500	2.0	0.999040
0.9	0.980205	2.5	0.999101
1.0	0.992019	3.0	0.999097
1.1	0.998453		
RHO= .70			
0.0	0.641003	1.2	0.991895
0.1	0.700700	1.3	0.993861
0.2	0.862116	1.4	0.995681
0.3	1.001010	1.5	0.997575
0.4	0.860628	1.6	0.997630
0.5	0.982526	1.7	0.998000
0.6	0.978677	1.8	0.998120
0.7	0.952092	1.9	0.998164
0.8	0.966123	2.0	0.998000
0.9	0.970468	2.5	0.998000
1.0	0.982500	3.0	0.998000
1.1	0.987495	3.5	0.998000

$\frac{P}{T}$ (°C)	$\frac{P}{T}$ (°C-1)	$\frac{P}{T}$ (°C-1)	$\frac{P}{T}$ (°C-1)
800-75			
0.0	0.7539767	1.3	0.9386105
0.1	0.8251160	1.0	0.9377531
0.2	0.8971990	1.5	0.9366101
0.3	0.7580110	1.6	0.9359105
0.4	0.8081735	2.0	0.9346111
0.5	0.8591910	1.8	0.9335115
0.6	0.8077365	1.9	0.9330106
0.7	0.8571910	2.0	0.9325111
0.8	0.8061910	2.5	0.9306105
0.9	0.9516105	3.0	0.9296109
1.0	0.8530105	3.5	0.9285112
1.1	0.9119122	4.0	0.9279109
1.2	0.7766199	4.5	0.9274106
800-60			
0.0	0.8663655	1.0	0.9561182
0.1	0.7320109	1.5	0.9734184
0.2	0.7723109	1.0	0.9781181
0.3	0.8426195	1.5	0.9833180
0.4	0.7225109	1.0	0.9855183
0.5	0.7756191	1.6	0.9851181
0.6	0.8200195	2.0	0.9842181
0.7	0.9563126	2.5	0.9870120
0.8	0.8080137	3.0	0.9897186
0.9	0.9067195	3.5	0.9915185
1.0	0.9205199	4.0	0.9906182
1.1	0.9319186	4.5	0.9898181
1.2	0.9310185	5.0	0.9895181
1.3	0.9401125	6.0	0.9890181
800-45			
0.0	0.8600189	1.5	0.9323106
0.1	0.8207127	1.6	0.9322109
0.2	0.8064109	1.7	0.9307109
0.3	0.8064109	1.8	0.9317109
0.4	0.8511067	1.9	0.9300187
0.5	0.8475152	2.0	0.9303106
0.6	0.7715191	2.5	0.9361112
0.7	0.7603110	3.0	0.9337106
0.8	0.7956105	1.5	0.9371109
0.9	0.8232121	4.0	0.9307109
1.0	0.8090110	4.5	0.9307109
1.1	0.8721105	5.0	0.9297125
1.2	0.8011172	6.0	0.9309106
1.3	0.8071130	7.0	0.9300106

$\frac{1}{T}$ (°C)	$\rho$ (g/cc)	$\eta$ (cP)	$\frac{\eta}{\rho}$ (cP/g)
25°C, 90			
0.0	0.252172	1.5	0.20322
0.1	0.200515	1.6	0.08507
0.2	0.132563	1.7	0.08046
0.3	0.085107	1.7	0.07977
0.4	0.055130	1.9	0.06555
0.5	0.314057	2.0	0.07713
0.6	0.563061	2.5	0.170058
0.7	0.407115	3.0	0.50330
0.8	0.460555	1.5	0.078168
0.9	0.005055	4.0	0.07112
1.0	0.171769	4.5	0.07221
1.1	0.111111	5.0	0.07273
1.2	0.165726	6.0	0.090278
1.3	0.708907	7.0	0.090628
1.4	0.005953	6.0	0.079795
25°C, 95			
0.0	0.120753	7.0	0.07336
0.1	0.121133	6.0	0.07529
1.0	0.675199	7.0	0.743101
2.0	0.003751	8.0	0.006570
3.0	0.018194		
25°C, 98			
0.0	0.053069	5.0	0.07133
0.1	0.130376	6.0	0.731231
2.0	0.250002	7.0	0.743032
3.0	0.751552	8.0	0.008219
4.0			
25°C, 99			
0.0	0.026002	5.0	0.006112
1.0	0.113567	6.0	0.063160
2.0	0.190203	7.0	0.105101
3.0	0.276787	8.0	0.560070







## M/D/7 COF OF WAITING TIME IN THE QUEUE

TIME T	P (WTC=T)	TIME T	P (WTC=T)
M/D-.10			
0.0	0.999991	0.2	0.999996
0.1	0.999996		
M/D-.20			
0.0	0.999377	0.4	0.999972
0.1	0.999660	0.5	0.999981
0.2	0.999838	0.6	0.999990
0.3	0.999926		
M/D-.30			
0.0	0.996097	0.4	0.999055
0.1	0.996617	0.5	0.999083
0.2	0.997221	0.6	0.999149
0.3	0.997910	0.7	0.999250
M/D-.40			
0.0	0.970055	0.6	0.999772
0.1	0.980681	0.7	0.999961
0.2	0.991390	0.8	0.999984
0.3	0.995630	0.9	0.999994
0.4	0.998950	1.0	0.999998
0.5	0.999260		
M/D-.50			
0.0	0.920769	0.8	0.999910
0.1	0.950205	0.9	0.999916
0.2	0.972333	1.0	0.999940
0.3	0.980710	1.1	0.999955
0.4	0.992020	1.2	0.999960
0.5	0.996402	1.3	0.999971
0.6	0.998710	1.4	0.999979
0.7	0.999520		
M/D-.55			
0.0	0.892910	0.9	0.999726
0.1	0.920365	1.0	0.999809
0.2	0.950670	1.1	0.999900
0.3	0.973130	1.2	0.999972
0.4	0.986202	1.3	0.999987
0.5	0.993427	1.4	0.999994
0.6	0.997122	1.5	0.999997
0.7	0.998764	1.6	0.999999
0.8	0.999130		
M/D-.60			
0.0	0.807500	1.0	0.999560
0.1	0.893005	1.1	0.999770
0.2	0.920606	1.2	0.999887
0.3	0.957013	1.3	0.999942
0.4	0.975779	1.4	0.999970
0.5	0.987001	1.5	0.999985
0.6	0.993006	1.6	0.999992
0.7	0.996062	1.7	0.999996
0.8	0.998030	1.8	0.999998
0.9	0.999173	1.9	0.999999
M/D-.65			
0.0	0.709067	1.1	0.999262
0.1	0.806000	1.2	0.999571
0.2	0.890259	1.3	0.999757
0.3	0.931073	1.4	0.999862
0.4	0.950710	1.5	0.999921
0.5	0.970519	1.6	0.999955
0.6	0.987110	1.7	0.999975
0.7	0.992007	1.8	0.999980
0.8	0.995957	1.9	0.999982
0.9	0.997663	2.0	0.999985
1.0	0.998463		
M/D-.70			
0.0	0.710003	1.1	0.997500
0.1	0.780606	1.2	0.998000
0.2	0.805633	1.3	0.998500
0.3	0.800205	1.4	0.999000
0.4	0.831310	1.5	0.999300
0.5	0.857310	1.6	0.999772
0.6	0.870052	1.7	0.999800
0.7	0.880110	1.8	0.999811
0.8	0.890073	1.9	0.999840
0.9	0.902700	2.0	0.999860
1.0	0.906000	2.5	0.999971
M/D-.75			
0.0	0.630003	1.2	0.990002
0.1	0.710700	1.3	0.990507
0.2	0.700000	1.4	0.991077
0.3	0.800000	1.5	0.992019
0.4	0.800112	1.6	0.993020
0.5	0.820170	1.7	0.994000
0.6	0.800200	1.8	0.995002
0.7	0.800000	1.9	0.996001
0.8	0.800702	2.0	0.997000
0.9	0.800000	2.5	0.999000
1.0	0.800130	3.0	0.999995
1.1	0.800010		
M/D-.80			
0.0	0.537221	1.3	0.990330
0.1	0.616700	1.4	0.991367
0.2	0.610200	1.5	0.992010
0.3	0.700120	1.6	0.993277
0.4	0.821007	1.7	0.994007
0.5	0.800100	1.8	0.995010
0.6	0.800507	1.9	0.996009
0.7	0.800000	2.0	0.997000
0.8	0.800000	2.5	0.999007
0.9	0.800000	3.0	0.999931
1.0	0.800110	3.5	0.999985
1.1	0.800000	4.0	0.999997
1.2	0.800221		
M/D-.85			
0.0	0.425000	1.4	0.990000
0.1	0.501720	1.5	0.990675
0.2	0.570770	1.6	0.991011
0.3	0.632333	1.7	0.991007
0.4	0.710702	1.8	0.991001
0.5	0.775205	1.9	0.991000
0.6	0.821037	2.0	0.991001
0.7	0.837007	2.5	0.997200
0.8	0.800000	3.0	0.999125
0.9	0.800000	3.5	0.999711
1.0	0.800000	4.0	0.999905
1.1	0.800000	4.5	0.999959
1.2	0.800000	5.0	0.999990
1.3	0.800000	6.0	0.999999
M/D-.90			
0.0	0.290272	1.4	0.990303
0.1	0.362700	1.5	0.991007
0.2	0.430010	1.6	0.992002
0.3	0.490205	1.7	0.993020
0.4	0.560500	1.8	0.994000
0.5	0.620000	1.9	0.995000
0.6	0.675702	2.0	0.995000
0.7	0.710000	2.5	0.997001
0.8	0.757003	3.0	0.998010
0.9	0.700105	3.5	0.998000
1.0	0.810000	4.0	0.999000
1.1	0.802000	4.5	0.999000
1.2	0.800100	5.0	0.999001
1.3	0.802500	6.0	0.999000
M/D-.95			
0.0	0.190000	3.0	0.995000
1.0	0.507000	4.0	0.998000
2.0	0.707010	5.0	0.999001
M/D-.99			
0.0	0.020513	3.0	0.990011
1.0	0.130000	4.0	0.991000
2.0	0.260000	5.0	0.991000









## M/D/9 COF OF WRITING TIME IN THE QUEUE

TIME T	P (UTC=T)	TIME T	P (UTC=T)	TIME T	P (UTC=T)	TIME T	P (UTC=T)	TIME T	P (UTC=T)	TIME T	P (UTC=T)	TIME T	P (UTC=T)	TIME T	P (UTC=T)	TIME T	P (UTC=T)
BRO-.10				BRO-.55				BRO-.75				BRO-.90					
0.0	1.000000			0.0	0.929992	0.7	0.999785	0.0	0.691612	1.1	0.999026	0.0	0.336294	1.0	0.995420		
BRO-.20				0.1	0.957709	0.8	0.999910	0.1	0.772045	1.2	0.999796	0.1	0.415104	1.5	0.954710		
0.0	0.999890	0.3	0.999993	0.2	0.976157	0.9	0.999948	0.2	0.841027	1.3	0.999264	0.2	0.498332	1.6	0.962611		
0.1	0.999950	0.4	0.999998	0.3	0.988592	1.0	0.999980	0.3	0.895548	1.4	0.999553	0.3	0.576826	1.7	0.969006		
0.2	0.999980			0.4	0.995092	1.1	0.999994	0.4	0.938958	1.5	0.999727	0.4	0.686089	1.8	0.976112		
BRO-.30				0.5	0.998160	1.2	0.999998	0.5	0.960861	1.6	0.999630	0.5	0.787212	1.9	0.978515		
0.0	0.999881	0.4	0.999950	0.6	0.999178			0.6	0.975591	1.7	0.999899	0.6	0.757690	2.0	0.982169		
0.1	0.999857	0.5	0.99987	BRO-.60				0.7	0.985796	1.8	0.999938	0.7	0.798958	2.5	0.992900		
0.2	0.999586	0.6	0.999998	0.0	0.891113	0.8	0.999788	0.8	0.991287	1.9	0.999962	0.8	0.832999	3.0	0.997236		
0.3	0.999842			0.1	0.931194	0.9	0.999872	0.9	0.996468	2.0	0.999877	0.9	0.861356	3.5	0.990812		
BRO-.40				0.2	0.968088	1.0	0.999905	1.0	0.996753	2.5	0.999996	1.0	0.888552	4.0	0.999572		
0.0	0.988161	0.4	0.999560	0.3	0.979805	1.1	0.999977	BRO-.80				1.1	0.988532	4.5	0.999031		
0.1	0.991690	0.5	0.999870	0.4	0.990200	1.2	0.999990	0.0	0.592835	1.2	0.999887	1.2	0.920771	5.0	0.999936		
0.2	0.996992	0.6	0.999976	0.5	0.995867	1.3	0.999996	0.1	0.680937	1.3	0.996503	BRO-.95					
0.3	0.998766	0.7	0.999996	0.6	0.998357	1.4	0.999998	0.2	0.761850	1.4	0.997626	0.0	0.178883	3.0	0.988606		
BRO-.50				0.7	0.999329			0.3	0.838165	1.5	0.998289	1.0	0.658312	4.0	0.977825		
0.0	0.957788	0.6	0.999773	BRO-.65				0.4	0.883383	1.6	0.998907	2.0	0.861622	BRO-.98			
0.1	0.975365	0.7	0.999936	0.0	0.899605	0.9	0.999536	0.5	0.921556	1.7	0.999258	BRO-.99					
0.2	0.987229	0.8	0.999979	0.1	0.903476	1.0	0.999771	0.6	0.947367	1.8	0.999697	0.0	0.073897	3.0	0.881908		
0.3	0.996096	0.9	0.999993	0.2	0.938529	1.1	0.999890	0.7	0.964336	1.9	0.999659	1.0	0.383309	4.0	0.778618		
0.4	0.997688	1.0	0.999998	0.3	0.963169	1.2	0.999967	0.8	0.975709	2.0	0.999768	2.0	0.542954	BRO-.99			
0.5	0.999218			0.4	0.981090	1.3	0.999976	0.9	0.983885	2.5	0.999967	BRO-.99					
BRO-.70				0.5	0.991005	1.4	0.999988	1.0	0.988799	3.0	0.999995	0.0	0.037367	3.0	0.838813		
0.0	0.773751	1.1	0.999517	0.6	0.995953	1.5	0.999996	1.1	0.992805	BRO-.85				1.0	0.189261	4.0	0.528284
0.1	0.881570	1.2	0.999737	0.7	0.998838	1.6	0.999997	0.0	0.473902	1.3	0.988386	2.0	0.323050	BRO-.99			
0.2	0.896455	1.3	0.999857	0.8	0.999956	1.7	0.999999	0.1	0.563697	1.4	0.988257	BRO-.99					
0.3	0.937172	1.4	0.999922	0.9	0.999994	1.8	0.999999	0.2	0.658560	1.5	0.988170	BRO-.99					
0.4	0.944508	1.5	0.999958	1.0	0.999998	1.9	0.999999	0.3	0.720996	1.6	0.988360	BRO-.99					
0.5	0.988970	1.6	0.999977	1.1	0.999999	2.0	0.999999	0.4	0.798886	1.7	0.988507	BRO-.99					
0.6	0.988956	1.7	0.999987	1.2	0.999999	2.5	0.999999	0.5	0.846652	1.8	0.988625	BRO-.99					
0.7	0.988586	1.8	0.999993	1.3	0.999999	3.0	0.999999	0.6	0.895359	1.9	0.988716	BRO-.99					
0.8	0.997021	1.9	0.999996	1.4	0.999999	3.5	0.999999	0.7	0.913848	2.0	0.988766	BRO-.99					
0.9	0.998364	2.0	0.999998	1.5	0.999999	4.0	0.999999	0.8	0.935884	2.5	0.988889	BRO-.99					
1.0	0.999110			1.6	0.999999	4.5	0.999999	0.9	0.951145	3.0	0.988977	BRO-.99					
				1.7	0.999999	5.0	0.999999	1.0	0.963271	3.5	0.989070	BRO-.99					
				1.8	0.999999			1.1	0.972389	4.0	0.989143	BRO-.99					
				1.9	0.999999			1.2	0.979218	4.5	0.989198	BRO-.99					



## M/D/10 CDF OF WAITING TIME IN THE QUEUE

TIME T	P (WTC=T)	TIME T	P (WTC=T)	TIME T	P (WTC=T)	TIME T	P (WTC=T)	TIME T	P (WTC=T)	TIME T	P (WTC=T)
M/D=.10				M/D=.55				M/D=.75			
0.0	1.000000			0.0	0.982591	0.6	0.999707	0.0	0.716969	1.1	0.999973
M/D=.20				0.1	0.987175	0.7	0.999900	0.1	0.706523	1.2	0.999987
0.0	0.999953	0.2	0.999993	0.2	0.983181	0.8	0.999969	0.2	0.694185	1.3	0.999998
0.1	0.999981	0.3	0.999998	0.3	0.992380	0.9	0.999989	0.3	0.675282	1.4	0.999999
M/D=.30				0.4	0.997086	1.0	0.999996	0.4	0.650217	1.5	0.999999
0.0	0.999895	0.3	0.999930	0.5	0.999010	1.1	0.999999	0.5	0.617559	1.6	0.999999
0.1	0.999907	0.4	0.999981	M/D=.60				0.6	0.606011	1.7	0.999999
0.2	0.999790	0.5	0.999996	0.0	0.987089	0.7	0.999970	0.7	0.590789	1.8	0.999999
M/D=.40				0.1	0.986296	0.8	0.999972	0.8	0.566680	1.9	0.999997
0.0	0.999895	0.3	0.999930	0.2	0.986651	0.9	0.999989	0.9	0.546900	2.0	0.999997
0.1	0.999907	0.4	0.999981	0.3	0.985279	1.0	0.999990	1.0	0.520217		
0.2	0.999790	0.5	0.999996	0.4	0.983717	1.1	0.999992	M/D=.80			
M/D=.50				0.5	0.981617	1.2	0.999997	0.0	0.695281	1.2	0.997066
0.0	0.991772	0.4	0.999788	0.6	0.999107	1.3	0.999999	0.1	0.670635	1.3	0.998079
0.1	0.995913	0.5	0.999849	M/D=.65				0.2	0.640403	1.4	0.998751
0.2	0.998200	0.6	0.999901	0.0	0.859172	0.0	0.999526	0.3	0.616620	1.5	0.999100
0.3	0.999319	0.7	0.999999	0.1	0.910505	0.9	0.999785	0.4	0.595516	1.6	0.999472
M/D=.55				0.2	0.908070	1.0	0.999895	0.5	0.579281	1.7	0.999657
0.0	0.986852	0.5	0.998611	0.3	0.922759	1.1	0.999954	0.6	0.560938	1.8	0.999777
0.1	0.981950	0.6	0.999006	0.4	0.927122	1.2	0.999981	0.7	0.546612	1.9	0.999855
0.2	0.981223	0.7	0.999076	0.5	0.930801	1.3	0.999992	0.8	0.533036	2.0	0.999906
0.3	0.986287	0.8	0.999083	0.6	0.937630	1.4	0.999996	0.9	0.520220	2.5	0.999989
0.4	0.988676	0.9	0.999090	0.7	0.940959	1.5	0.999998	1.0	0.502900	3.0	0.999999
M/D=.60				M/D=.70				M/D=.85			
0.0	0.982591	0.6	0.999707	0.0	0.795672	1.0	0.999573	0.0	0.495162	1.3	0.999950
0.1	0.987175	0.7	0.999900	0.1	0.862683	1.1	0.999783	0.1	0.500409	1.4	0.999970
0.2	0.983181	0.8	0.999969	0.2	0.910638	1.2	0.999890	0.2	0.600848	1.5	0.999666
0.3	0.992380	0.9	0.999989	0.3	0.951292	1.3	0.999984	0.3	0.700175	1.6	0.999110
0.4	0.997086	1.0	0.999996	0.4	0.978360	1.4	0.999971	0.4	0.820470	1.7	0.997168
0.5	0.999010	1.1	0.999999	0.5	0.987237	1.5	0.999986	0.5	0.872905	1.8	0.997037
M/D=.65				0.6	0.993709	1.6	0.999993	0.6	0.907957	1.9	0.998077
0.0	0.986852	0.5	0.998611	0.7	0.996816	1.7	0.999996	0.7	0.932923	2.0	0.998085
0.1	0.981950	0.6	0.999006	0.8	0.998350	1.8	0.999998	0.8	0.951027	2.5	0.999775
0.2	0.981223	0.7	0.999076	0.9	0.999159			0.9	0.960311	3.0	0.999954
0.3	0.986287	0.8	0.999083	M/D=.75				1.0	0.974809	3.5	0.999991
0.4	0.988676	0.9	0.999090	0.0	0.716969	1.1	0.999973	1.1	0.981860	4.0	0.999998
M/D=.70				0.1	0.706523	1.2	0.999987	1.2	0.986287		
0.0	0.716969	1.1	0.999973	0.2	0.694185	1.3	0.999998	M/D=.80			
0.1	0.706523	1.2	0.999987	0.3	0.675282	1.4	0.999999	0.0	0.553139	1.4	0.959940
0.2	0.694185	1.3	0.999998	0.4	0.650217	1.5	0.999999	0.1	0.538565	1.5	0.987625
0.3	0.675282	1.4	0.999999	0.5	0.617559	1.6	0.999999	0.2	0.525388	1.6	0.973528
0.4	0.650217	1.5	0.999999	0.6	0.606011	1.7	0.999999	0.3	0.607675	1.7	0.970681
0.5	0.617559	1.6	0.999999	0.7	0.590789	1.8	0.999999	0.4	0.600468	1.8	0.962587
0.6	0.606011	1.7	0.999999	0.8	0.566680	1.9	0.999997	0.5	0.581186	1.9	0.955780
0.7	0.590789	1.8	0.999999	0.9	0.546900	2.0	0.999997	0.6	0.560110	2.0	0.948881
0.8	0.566680	1.9	0.999997	1.0	0.520217			0.7	0.529369	2.5	0.995697
0.9	0.546900	2.0	0.999997	M/D=.85				0.8	0.501183	3.0	0.998584
1.0	0.520217			0.0	0.695281	1.2	0.997066	0.9	0.507122	3.5	0.999493
M/D=.90				0.1	0.670635	1.3	0.998079	1.0	0.500256	4.0	0.999836
0.0	0.553139	1.4	0.959940	0.2	0.640403	1.4	0.998751	1.1	0.425427	4.5	0.999835
0.1	0.538565	1.5	0.987625	0.3	0.616620	1.5	0.999100	1.2	0.420379	5.0	0.999877
0.2	0.525388	1.6	0.973528	0.4	0.595516	1.6	0.999472	1.3	0.450720		
0.3	0.607675	1.7	0.970681	0.5	0.579281	1.7	0.999657	M/D=.95			
0.4	0.600468	1.8	0.962587	0.6	0.560938	1.8	0.999777	0.0	0.100358	2.0	0.880150
0.5	0.581186	1.9	0.955780	0.7	0.546612	1.9	0.999855	1.0	0.690690	3.0	0.959559
0.6	0.560110	2.0	0.948881	0.8	0.533036	2.0	0.999906	M/D=.98			
0.7	0.529369	2.5	0.995697	0.9	0.520220	2.5	0.999989	0.0	0.670211	3.0	0.570983
0.8	0.501183	3.0	0.998584	1.0	0.502900	3.0	0.999999	1.0	0.371591	3.0	0.710161
0.9	0.507122	3.5	0.999493	M/D=.99				M/D=.99			
1.0	0.500256	4.0	0.999836	0.0	0.695281	2.0	0.959940	0.0	0.695281	2.0	0.350983
1.1	0.425427	4.5	0.999835	0.1	0.670635	3.0	0.980150	1.0	0.206657	3.0	0.860821
1.2	0.420379	5.0	0.999877								

STATE 1				STATE 2				STATE 3				STATE 4			
PIA=11	PINC=11	PIA=11	PINC=11	PIA=11	PINC=11	PIA=11	PINC=11	PIA=11	PINC=11	PIA=11	PINC=11	PIA=11	PINC=11		
RHO=10				RHO=70				RHO=95							
1 .301194	0.001194	6 .124911E-02	0.999749	0 .701128E-03	0.000201	14 .266746E-01	0.963783	0 .297287E-05	0.000203	22 .290057E-01	0.725685	23 .265954E-01	0.752004		
1 .301194	0.001201	7 .211114E-02	0.999749	1 .718200E-02	0.000400	15 .161183E-01	0.979961	1 .345603E-04	0.000010	23 .265954E-01	0.752004	24 .239818E-01	0.776023		
2 .216880	0.879487	8 .321200E-04	0.999999	2 .718200E-02	0.000400	15 .161183E-01	0.979961	2 .201508E-01	0.000210	24 .239818E-01	0.776023	25 .216880E-01	0.797666		
1 .886739E-01	0.966231	9 .826216E-05	0.999999	3 .202551E-01	0.029342	17 .511216E-02	0.996167	3 .786135E-01	0.000100	25 .216880E-01	0.797666	26 .156577E-01	0.813229		
5 .268232E-01	0.992256	10 .513112E-06	1.000000	4 .429120E-01	0.072254	18 .137258E-02	0.990709	4 .210535E-02	0.003336	26 .156577E-01	0.813229	27 .176577E-01	0.834929		
5 .429596E-02	0.998750	11 .586041E-07	1.000000	5 .728164E-01	0.145073	19 .242158E-02	0.998507	5 .345982E-07	0.000196	27 .176577E-01	0.834929	28 .159658E-01	0.850895		
RHO=20				RHO=75				RHO=95							
0 .907178E-01	0.040718	8 .267668E-02	0.999138	0 .100157	0.268230	20 .234148E-03	0.999241	6 .108207E-01	0.019616	28 .159658E-01	0.850895	29 .521476E-01	0.865191		
1 .217121	0.346491	9 .384564E-02	0.999138	1 .217121	0.346491	21 .234148E-03	0.999241	7 .183216E-01	0.038164	29 .521476E-01	0.865191	30 .176577E-01	0.878393		
2 .261240	0.569708	10 .275390E-02	0.999138	2 .261240	0.569708	22 .234148E-03	0.999241	8 .405211E-01	0.131606	30 .176577E-01	0.878393	31 .176577E-01	0.891290		
3 .200014	0.774723	11 .343813E-04	0.999999	3 .200014	0.774723	23 .261240E-04	0.999901	9 .381620E-01	0.104339	31 .176577E-01	0.891290	32 .176278E-01	0.900739		
4 .125405	0.904131	12 .691649E-05	0.999999	4 .125405	0.904131	24 .261240E-04	0.999901	10 .275390E-01	0.206481	32 .176278E-01	0.900739	33 .840709E-02	0.910304		
5 .091967E-01	0.966327	13 .127619E-05	1.000000	5 .091967E-01	0.966327	25 .261240E-04	0.999901	12 .590061E-01	0.235542	33 .840709E-02	0.910304	34 .067209E-02	0.919102		
5 .240785E-01	0.986805	14 .218904E-06	1.000000	5 .240785E-01	0.986805	26 .261240E-04	0.999901	13 .127619E-01	0.266504	34 .067209E-02	0.919102	35 .167331E-02	0.928605		
7 .825555E-02	0.996661	15 .350249E-07	1.000000	7 .825555E-02	0.996661	27 .261240E-04	0.999901	14 .218904E-01	0.385540	35 .167331E-02	0.928605	36 .125668E-02	0.938129		
RHO=30				RHO=80				RHO=98							
0 .273210E-01	0.027321	9 .764921E-02	0.999574	0 .102804E-03	0.000103	16 .168177E-01	0.975048	0 .890892E-06	0.000001	22 .246372E-01	0.400595	23 .236647E-01	0.424296		
1 .983574E-01	0.125679	10 .275390E-02	0.999574	1 .983574E-01	0.125679	17 .102804E-01	0.985337	1 .107110E-04	0.000012	23 .236647E-01	0.424296	24 .225205E-01	0.446981		
2 .177048															

[illegible]



## M/D/15 CDF OF WAITING TIME IN THE QUEUE

TIME T	P (WTC=T)	TIME T	P (WTC=T)	TIME T	P (WTC=T)	TIME T	P (WTC=T)	TIME T	P (WTC=T)	TIME T	P (WTC=T)
M/D= .10				M/D= .55				M/D= .75			
0.0	1.000000			0.0	0.977011	0.0	0.999707	0.0	0.999510	0.0	0.999510
M/D= .20				0.1	0.990130	0.1	0.999955	0.1	0.999700	0.1	0.999700
0.0	1.000000			0.2	0.996370	0.2	0.999993	0.2	0.999904	0.2	0.999904
M/D= .30				0.3	0.998910	0.3	0.999999	0.3	0.999960	0.3	0.999960
0.0	1.000000			M/D= .60				0.4	0.999960	0.4	0.999960
M/D= .40				0.0	0.956109	0.3	0.999801	0.5	0.999952	0.5	0.999952
0.0	0.999926	0.2	0.999999	0.1	0.979010	0.5	0.999999	0.6	0.999977	0.6	0.999977
0.1	0.999977	0.3	0.999999	0.2	0.991701	0.7	0.999992	0.7	0.999999	0.7	0.999999
M/D= .10				0.3	0.977295	0.0	0.999999	0.8	0.999999	0.8	0.999999
0.0	0.999999	0.2	0.999999	0.4	0.999202			0.9	0.999999	0.9	0.999999
0.1	0.999999	0.4	0.999999	M/D= .65				1.0	0.999999	1.0	0.999999
0.2	0.999999			0.0	0.922279	0.6	0.999807	0.0	0.999601	1.1	0.999601
M/D= .50				0.1	0.968572	0.7	0.999953	0.1	0.999607	1.2	0.999607
0.0	0.999979	0.0	0.999999	0.2	0.988701	0.0	0.999999	0.2	0.999601		
0.1	0.999999	0.3	0.999999	0.3	0.996500	0.9	0.999999	0.4	0.999607		
0.2	0.999999	0.5	0.999999	0.4	0.999022	1.0	0.999999	0.5	0.999607		
0.3	0.999999			0.5	0.999055			0.6	0.999607		
M/D= .70				M/D= .70				0.7	0.999607		
0.0	0.971735	0.2	0.999705	0.0	0.971735	0.2	0.999705	0.8	0.999607		
0.1	0.990002	0.0	0.999999	0.1	0.990002	0.0	0.999999	0.9	0.999607		
0.2	0.990000	0.9	0.999999	0.2	0.990000	0.9	0.999999	1.0	0.999607		
0.3	0.990000	1.0	0.999999	0.3	0.990000	1.0	0.999999				
0.4	0.990000	1.1	0.999999	0.4	0.990000	1.1	0.999999				
0.5	0.990000	1.2	0.999999	0.5	0.990000	1.2	0.999999				
0.6	0.990000			0.6	0.990000						
M/D= .85				M/D= .85				M/D= .90			
0.0	0.999999			0.0	0.999999			0.0	0.999999		
0.1	0.999999			0.1	0.999999			0.1	0.999999		
0.2	0.999999			0.2	0.999999			0.2	0.999999		
0.3	0.999999			0.3	0.999999			0.3	0.999999		
0.4	0.999999			0.4	0.999999			0.4	0.999999		
0.5	0.999999			0.5	0.999999			0.5	0.999999		
0.6	0.999999			0.6	0.999999			0.6	0.999999		
0.7	0.999999			0.7	0.999999			0.7	0.999999		
0.8	0.999999			0.8	0.999999			0.8	0.999999		
0.9	0.999999			0.9	0.999999			0.9	0.999999		
1.0	0.999999			1.0	0.999999			1.0	0.999999		

## Tables for D/M/c Queueing Systems

The Model: Individual customers arrive at constant intervals;  
service times have an exponential distribution;  
 $c$  servers operate in parallel.

Notation: See Section 1.2.

Tables Included:  $L_q$ ,  $P(N = I)$  and  $P(N \leq I)$ ,  $P(WT \leq T)$  for  $c = 1, 2, \dots$ ,  
10, 15.



## EXPECTED LENGTH OF QUEUE FOR D/M/c

c:	1	2	3	4
RHO				
0.10	0.45423E-05	0.30812E-07	0.21410E-09	0.15247E-11
0.20	0.14052E-02	0.12486E-03	0.11945E-04	0.11909E-05
0.30	0.12787E-01	0.28793E-02	0.70979E-03	0.18322E-03
0.40	0.48109E-01	0.17856E-01	0.72505E-02	0.30815E-02
0.50	0.12750E 00	0.64914E-01	0.35801E-01	0.20580E-01
0.55	0.19405E 00	0.11121E 00	0.68573E-01	0.43935E-01
0.60	0.28789E 00	0.18237E 00	0.12336E 00	0.86386E-01
0.65	0.42102E 00	0.29060E 00	0.21246E 00	0.16017E 00
0.70	0.61332E 00	0.45599E 00	0.35613E 00	0.28557E 00
0.75	0.90056E 00	0.71450E 00	0.59051E 00	0.49885E 00
0.80	0.13542E 01	0.11378E 01	0.98742E 00	0.87201E 00
0.85	0.21410E 01	0.18927E 01	0.17139E 01	0.15723E 01
0.90	0.37508E 01	0.34794E 01	0.32703E 01	0.31002E 01
0.95	0.87142E 01	0.83980E 01	0.81570E 01	0.79563E 01
0.98	0.23686E 02	0.23348E 02	0.23087E 02	0.22868E 02
0.99	0.48683E 02	0.48331E 02	0.48064E 02	0.47837E 02

c:	5	6	7	8
RHO				
0.10	0.11059E-13	0.81301E-16	0.60378E-18	0.45192E-20
0.20	0.12178E-06	0.12665E-07	0.13331E-08	0.14161E-09
0.30	0.48600E-04	0.13125E-04	0.35900E-05	0.99121E-06
0.40	0.13459E-02	0.59863E-03	0.26970E-03	0.12267E-03
0.50	0.12136E-01	0.72814E-02	0.44233E-02	0.27123E-02
0.55	0.28828E-01	0.19228E-01	0.12978E-01	0.88396E-02
0.60	0.61829E-01	0.44928E-01	0.33012E-01	0.24464E-01
0.65	0.12312E 00	0.95939E-01	0.75520E-01	0.59915E-01
0.70	0.23289E 00	0.19220E 00	0.16005E 00	0.13420E 00
0.75	0.42742E 00	0.36991E 00	0.32256E 00	0.28295E 00
0.80	0.77883E 00	0.70122E 00	0.63520E 00	0.57818E 00
0.85	0.14545E 01	0.13537E 01	0.12656E 01	0.11876E 01
0.90	0.29553E 01	0.28284E 01	0.27151E 01	0.26126E 01
0.95	0.77819E 01	0.76262E 01	0.74848E 01	0.73547E 01
0.98	0.22674E 02	0.22500E 02	0.22341E 02	0.22193E 02
0.99	0.47638E 02	0.47457E 02	0.47291E 02	0.47137E 02

c:	9	10	15
RHO			
0.10	0.34036E-22	0.25764E-24	0.00000E 00
0.20	0.15148E-10	0.16295E-11	0.24821E-16
0.30	0.27568E-06	0.77121E-07	0.13925E-09
0.40	0.56212E-04	0.25910E-04	0.57125E-06
0.50	0.16753E-02	0.10409E-02	0.10211E-03
0.55	0.60636E-02	0.41832E-02	0.69215E-03
0.60	0.18253E-01	0.13693E-01	0.34396E-02
0.65	0.47833E-01	0.38383E-01	0.13453E-01
0.70	0.11316E 00	0.95858E-01	0.43848E-01
0.75	0.24941E 00	0.22071E 00	0.12491E 00
0.80	0.52934E 00	0.48438E 00	0.32478E 00
0.85	0.11177E 01	0.10545E 01	0.80950E 00
0.90	0.25190E 01	0.24327E 01	0.20806E 01
0.95	0.72340E 01	0.71211E 01	0.66411E 01
0.98	0.22054E 02	0.21924E 02	0.21358E 02
0.99	0.46993E 02	0.46856E 02	0.46260E 02



[illegible]

STATE	P(=1)	P(<1)	STATE	P(=1)	P(<1)	STATE	P(=1)	P(<1)	STATE	P(=1)	P(<1)	STATE	P(=1)	P(<1)
0	0.000678	0.000678	4	0.28845558-20	0.999999	8	0.9050422-01	0.095058	12	0.48048037-02	0.000480	16	0.28784575-02	0.000480
1	0.190463	0.099321	5	0.1131278-20	0.999999	9	0.1300803	0.040081	13	0.2708192-01	0.031942	17	0.2963955-02	0.000480
2	0.6783052-03	0.999999	6	0.9555082-20	0.999999	10	0.270381	0.051332	14	0.3863035-01	0.022325	18	0.3855225-02	0.011654
3	0.330812-07	0.999999	7	0.2901202-23	0.999999	11	0.187527	0.028259	15	0.3056118-01	0.009462	19	0.370537-02	0.018538
4	0.189373-11	0.999999	8	0.1228728-37	0.999999	12	0.0017558-01	0.000175	16	0.3519358-01	0.007964	20	0.408082-02	0.026638
5	0.356022-16	0.999999	9	0.0050925-42	0.999999	13	0.0391648-01	0.007267	17	0.3494782-01	0.017854	21	0.395456-02	0.016546
6	0.173771	0.061771	7	0.2917788-12	1.000000	14	0.2396152-01	0.017220	18	0.3264679-01	0.021200	22	0.2642758-02	0.031628
7	0.164659	0.082230	8	0.2035789-14	1.000000	15	0.1307313-01	0.004103	19	0.3130225-01	0.024254	23	0.2898772-02	0.041101
8	0.1746645-01	0.099877	9	0.1420392-16	1.000000	16	0.122857-01	0.009995	20	0.3009508-01	0.027436	24	0.3687788-02	0.051907
9	0.1231272-03	0.000000	10	0.0910300-19	1.000000	17	0.0891719-02	0.005126	21	0.2888978-01	0.030154	25	0.4647472-02	0.060731
10	0.189373-11	0.000000	11	0.0914589-21	1.000000	18	0.1158057-02	0.018608	22	0.2559717-01	0.035914	26	0.3165782-02	0.073819
11	0.0953102-08	1.000000	12	0.0049777-23	1.000000	19	0.1310077-01	0.009920	23	0.2358778-01	0.038126	27	0.4884108-03	0.074622
12	0.161908-10	1.000000	13	0.3384063-25	1.000000	20	0.164070-01	0.009955	24	0.2559730-01	0.040647	28	0.7212398-03	0.082546
13	0.067553	0.067558	14	0.3034878-09	1.000000	21	0.2259422-01	0.045213	25	0.2559730-01	0.040647	29	0.5114485-03	0.080836
14	0.649708	0.032455	15	0.1231638-10	1.000000	22	0.1750882-01	0.047111	26	0.2358778-01	0.038126	30	0.3130225-01	0.024254
15	0.649708-01	0.097238	16	0.5035633-12	1.000000	23	0.1750882-01	0.047111	27	0.2358778-01	0.038126	31	0.3130225-01	0.024254
16	0.2606659-02	0.999887	17	0.6084553-13	1.000000	24	0.1750882-01	0.047111	28	0.2358778-01	0.038126	32	0.3130225-01	0.024254
17	0.189373-11	0.000000	18	0.3454778-15	1.000000	25	0.1750882-01	0.047111	29	0.2358778-01	0.038126	33	0.3130225-01	0.024254
18	0.469205	0.000000	19	0.3454778-15	1.000000	26	0.1750882-01	0.047111	30	0.2358778-01	0.038126	34	0.3130225-01	0.024254
19	0.189373-11	0.000000	20	0.1412246-17	1.000000	27	0.1750882-01	0.047111	31	0.2358778-01	0.038126	35	0.3130225-01	0.024254
20	0.7399842-08	0.000000	21	0.5773565-19	1.000000	28	0.1750882-01	0.047111	32	0.2358778-01	0.038126	36	0.31302	

## D/M/2 COF OF WAITING TIME IN THE QUEUE

T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P
TIME	P (SEC+T)	TIME	P (SEC+T)	TIME	P (SEC+T)	TIME	P (SEC+T)	TIME	P (SEC+T)	TIME	P (SEC+T)	TIME	P (SEC+T)	TIME	P (SEC+T)
BRO-10															
0.0	1.000000	0.0	0.720673	2.2	0.963215	0.0	0.367190	3.5	0.603637	0.0	0.533065	22.0	0.612036	0.0	0.612036
0.1	0.999999	0.1	0.752060	2.3	0.968316	0.1	0.370994	4.0	0.613667	0.1	0.557215	24.0	0.613667	0.1	0.557215
0.2	0.999998	0.2	0.774091	2.4	0.971140	0.2	0.400122	4.5	0.619042	0.2	0.581082	26.0	0.619042	0.2	0.581082
0.3	0.999997	0.3	0.794737	2.5	0.972713	0.3	0.427504	5.0	0.624801	0.3	0.604061	28.0	0.624801	0.3	0.604061
0.4	0.999996	0.4	0.813236	2.6	0.974566	0.4	0.466406	6.0	0.616777	0.4	0.616777	30.0	0.616777	0.4	0.616777
0.5	0.999995	0.5	0.829085	2.7	0.976190	0.5	0.466669	7.0	0.616669	0.5	0.616669	32.0	0.616669	0.5	0.616669
0.6	0.999994	0.6	0.845049	2.8	0.978135	0.6	0.462211	8.0	0.615305	0.6	0.615305	34.0	0.615305	0.6	0.615305
0.7	0.999993	0.7	0.858082	2.9	0.980195	0.7	0.462211	9.0	0.615305	0.7	0.615305	36.0	0.615305	0.7	0.615305
0.8	0.999992	0.8	0.871488	3.0	0.982518	0.8	0.462211	10.0	0.615305	0.8	0.615305	38.0	0.615305	0.8	0.615305
0.9	0.999991	0.9	0.882903	3.5	0.980666	0.9	0.511629	11.0	0.608003	0.9	0.608003	40.0	0.608003	0.9	0.608003
1.0	0.999990	1.0	0.893202	4.0	0.982521	1.0	0.547030	12.0	0.608003	1.0	0.608003	42.0	0.608003	1.0	0.608003
1.1	0.999989	1.1	0.902568	4.5	0.985930	1.1	0.547030	13.0	0.608003	1.1	0.608003	44.0	0.608003	1.1	0.608003
1.2	0.999988	1.2	0.911510	5.0	0.987453	1.2	0.576329	14.0	0.601133	1.2	0.601133	46.0	0.601133	1.2	0.601133
1.3	0.999987	1.3	0.919198	6.0	0.980099	1.3	0.590265	15.0	0.600000	1.3	0.600000	48.0	0.600000	1.3	0.600000
1.4	0.999986	1.4	0.926345	7.0	0.980099	1.4	0.607313	16.0	0.600000	1.4	0.600000	50.0	0.600000	1.4	0.600000
1.5	0.999985	1.5	0.933123	8.0	0.973209	1.5	0.616135	17.0	0.600000	1.5	0.600000	52.0	0.600000	1.5	0.600000
1.6	0.999984	1.6	0.939909	9.0	0.969939	1.6	0.629365	18.0	0.600000	1.6	0.600000	54.0	0.600000	1.6	0.600000
1.7	0.999983	1.7	0.946510	10.0	0.969939	1.7	0.640152	19.0	0.600000	1.7	0.600000	56.0	0.600000	1.7	0.600000
1.8	0.999982	1.8	0.944510	11.0	0.969939	1.8	0.651138	20.0	0.600000	1.8	0.600000	58.0	0.600000	1.8	0.600000
1.9	0.999981	1.9	0.944510	12.0	0.969939	1.9	0.664713	21.0	0.600000	1.9	0.600000	60.0	0.600000	1.9	0.600000
2.0	0.999980	2.0	0.950733	13.0	0.969939	2.0	0.675761	24.0	0.600000	2.0	0.600000	62.0	0.600000	2.0	0.600000
2.1	0.999979	2.1	0.950733	14.0	0.969939	2.1	0.686423	26.0	0.600000	2.1	0.600000	64.0	0.600000	2.1	0.600000
2.2	0.999978	2.2	0.950733												







STATE 1		STATE 2		STATE 3		STATE 4		STATE 5		STATE 6		STATE 7		STATE 8		STATE 9		STATE 10	
P (R=1)	P (R=2)	P (R=1)	P (R=2)	P (R=1)	P (R=2)	P (R=1)	P (R=2)	P (R=1)	P (R=2)	P (R=1)	P (R=2)	P (R=1)	P (R=2)	P (R=1)	P (R=2)	P (R=1)	P (R=2)	P (R=1)	P (R=2)
BRO=10																			
0.17804	0.617804	6.39247E-16	0.999999	0.100820	0.010482	14.240131E-01	0.999700	0.370861E-01	0.007381	56.456558E-02	0.888467	0.136472	0.982276	7.316347E-10	0.999999	1.428127E-02	0.004399	58.921037E-02	0.898282
2.176427E-01	0.999919	8.102855E-20	0.999999	2.218401	0.311641	16.111372E-01	0.999842	2.165484E-01	0.821188	60.368247E-02	0.904167	0.802318E-01	0.999999	9.448181E-01	0.999999	2.165484E-01	0.821188	60.368247E-02	0.904167
0.35110E-01	0.999999	9.448181E-01	0.999999	3.272849	0.580450	17.716737E-01	0.999935	3.272849	0.580450	64.103147E-02	0.920213	0.35110E-01	0.999999	9.448181E-01	0.999999	2.165484E-01	0.821188	60.368247E-02	0.904167
0.35110E-01	0.999999	9.448181E-01	0.999999	3.272849	0.580450	17.716737E-01	0.999935	3.272849	0.580450	64.103147E-02	0.920213	0.35110E-01	0.999999	9.448181E-01	0.999999	2.165484E-01	0.821188	60.368247E-02	0.904167
0.152452E-11	0.999999	1.133381E-37	0.999999	5.103001	0.876324	19.213727E-01	0.999974	5.103001	0.876324	68.204042E-02	0.926427	0.152452E-11	0.999999	1.133381E-37	0.999999	2.165484E-01	0.821188	60.368247E-02	0.904167
BRO=20																			
0.35112E-01	0.999999	7.571652E-10	1.000000	7.306617E-01	0.641381	20.161677E-01	0.999985	7.306617E-01	0.641381	64.204042E-02	0.926427	0.35112E-01	0.999999	7.571652E-10	1.000000	2.165484E-01	0.821188	60.368247E-02	0.904167
0.506799	0.858015	0.398878E-12	1.000000	9.127505E-02	0.389040	23.193727E-01	0.999997	9.127505E-02	0.389040	68.204042E-02	0.926427	0.506799	0.858015	0.398878E-12	1.000000	2.165484E-01	0.821188	60.368247E-02	0.904167
1.212922	0.999999	2.781035E-16	1.000000	11.271765E-02	0.996737	23.562870E-01	0.999999	11.271765E-02	0.996737	64.103147E-02	0.920213	1.212922	0.999999	2.781035E-16	1.000000	2.165484E-01	0.821188	60.368247E-02	0.904167
0.68037E-05	1.000000	0.181177E-10	1.000000	13.146288E-02	0.988182	23.702105E-01	0.999999	13.146288E-02	0.988182	68.204042E-02	0.926427	0.68037E-05	1.000000	0.181177E-10	1.000000	2.165484E-01	0.821188	60.368247E-02	0.904167
0.168317E-03	0.999998	1.135408E-18	1.000000	13.088539E-02	0.999028	23.702105E-01	0.999999	13.088539E-02	0.999028	68.204042E-02	0.926427	0.168317E-03	0.999998	1.135408E-18	1.000000	2.165484E-01	0.821188	60.368247E-02	0.904167
0.176377E-05	1.000000	12.985268E-21	1.000000	13.088539E-02	0.999028	23.702105E-01	0.999999	13.088539E-02	0.999028	68.204042E-02	0.926427	0.176377E-05	1.000000	12.985268E-21	1.000000	2.165484E-01	0.821188	60.368247E-02	0.904167
0.619370E-08	1.000000	13.659326E-23	1.000000	BRO=30															
BRO=30																			
0.196250																			





## D/M/S

COF OF NUMBER IN SYSTEM

STATE	P (N=1)	P (N<1)	STATE	P (N=1)	P (N<1)	STATE	P (N=1)	P (N<1)	STATE	P (N=1)	P (N<1)
1			1			1			1		
2			2			2			2		
3			3			3			3		
4			4			4			4		
5			5			5			5		
6			6			6			6		
7			7			7			7		
8			8			8			8		
9			9			9			9		
10			10			10			10		
11			11			11			11		
12			12			12			12		
13			13			13			13		
14			14			14			14		
15			15			15			15		
16			16			16			16		
17			17			17			17		
18			18			18			18		
19			19			19			19		
20			20			20			20		
21			21			21			21		
22			22			22			22		
23			23			23			23		
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71			71			71			71		
72			72			72			72		
73			73			73			73		
74			74			74			74		
75			75			75			75		
76			76			76			76		
77			77			77			77		
78			78			78			78		
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95			95			95			95		
96			96			96			96		
97			97			97			97		
98			98			98			98		
99			99			99			99		
100			100			100			100		





T1000				T1000				T1000				T1000				T1000				T1000			
P (TTC=7)				P (TTC=7)				P (TTC=7)				P (TTC=7)				P (TTC=7)				P (TTC=7)			
BRO= .10				BRO= .65				BRO= .65				BRO= .65				BRO= .90				BRO= .90			
0.0	1.000000			0.0	0.910022	2.1	0.907392	0.0	0.567191	3.0	0.633996	0.0	0.887762	22.0	0.626123	0.0	0.910022	2.1	0.907392	0.0	0.567191	3.0	0.633996
				0.1	0.910000	2.2	0.908516	0.1	0.562270	3.5	0.639554	0.1	0.891803	24.0	0.655263	0.1	0.910000	2.2	0.908516	0.1	0.562270	3.5	0.639554
				0.2	0.925681	2.3	0.909539	0.2	0.576667	4.0	0.641175	0.2	0.901175	26.0	0.682606	0.2	0.925681	2.3	0.909539	0.2	0.576667	4.0	0.641175
				0.3	0.938064	2.4	0.910000	0.3	0.590816	4.5	0.650100	0.3	0.910000	28.0	0.706156	0.3	0.938064	2.4	0.910000	0.3	0.590816	4.5	0.650100
				0.4	0.938360	2.5	0.911211	0.4	0.604009	5.0	0.651868	0.4	0.924666	30.0	0.739606	0.4	0.938360	2.5	0.911211	0.4	0.604009	5.0	0.651868
				0.5	0.943037	2.6	0.912059	0.5	0.617069	5.5	0.653917	0.5	0.938064	32.0	0.760740	0.5	0.943037	2.6	0.912059	0.5	0.617069	5.5	0.653917
				0.6	0.948804	2.7	0.912000	0.6	0.628660	6.0	0.656419	0.6	0.943037	34.0	0.780156	0.6	0.948804	2.7	0.912000	0.6	0.628660	6.0	0.656419
				0.7	0.953408	2.8	0.913811	0.7	0.641175	6.5	0.658868	0.7	0.948804	36.0	0.800156	0.7	0.953408	2.8	0.913811	0.7	0.641175	6.5	0.658868
				0.8	0.957557	2.9	0.915026	0.8	0.653415	7.0	0.661868	0.8	0.953408	38.0	0.820156	0.8	0.957557	2.9	0.915026	0.8	0.653415	7.0	0.661868
				0.9	0.961381	3.0	0.916559	0.9	0.665000	7.5	0.664316	0.9	0.957557	40.0	0.840156	0.9	0.961381	3.0	0.916559	0.9	0.665000	7.5	0.664316
				1.0	0.964787	3.5	0.916500	1.0	0.676020	8.0	0.666510	1.0	0.964787	42.0	0.860156	1.0	0.964787	3.5	0.916500	1.0	0.676020	8.0	0.666510
				1.1	0.967934	4.0	0.916511	1.1	0.686617	8.5	0.668617	1.1	0.967934	44.0	0.880156	1.1	0.967934	4.0	0.916511	1.1	0.686617	8.5	0.668617
				1.2	0.970303	4.5	0.916519	1.2	0.696975	9.0	0.670938	1.2	0.970303	46.0	0.900156	1.2	0.970303	4.5	0.916519	1.2	0.696975	9.0	0.670938
				1.3	0.973393	5.0	0.916519	1.3	0.706393	9.5	0.673040	1.3	0.973393	48.0	0.920156	1.3	0.973393	5.0	0.916519	1.3	0.706393	9.5	0.673040
				1.4	0.975762	5.5	0.916519	1.4	0.716576	10.0	0.675046	1.4	0.975762	50.0	0.940156	1.4	0.975762	5.5	0.916519	1.4	0.716576	10.0	0.675046
				1.5	0.977622	6.0	0.916519	1.5	0.725995	10.5	0.677046	1.5	0.977622	52.0	0.960156	1.5	0.977622	6.0	0.916519	1.5	0.725995	10.5	0.677046
				1.6	0.979400	6.5	0.916519	1.6	0.734900	11.0	0.678046	1.6	0.979400	54.0	0.980156	1.6	0.979400	6.5	0.916519	1.6	0.734900	11.0	0.678046
				1.7	0.981403	7.0	0.919900	1.7	0.743403	11.5	0.679046	1.7	0.981403	56.0	1.000156	1.7	0.981403	7.0	0.919900	1.7	0.743403	11.5	0.679046
				1.8	0.983316	7.5	0.919900	1.8	0.752903	12.0	0.680046	1.8	0.983316	58.0	1.020156	1.8	0.983316	7.5	0.919900	1.8	0.752903	12.0	0.680046
				1.9	0.984803	8.0	0.919900	1.9	0.762003	12.5	0.681046	1.9	0.984803	60.0	1.040156	1.9	0.984803	8.0	0.919900	1.9	0.762003	12.5	0.681046
				2.0	0.986190	12.0	0.919900	2.0	0.771500	13.0	0.682046	2.0	0.986190	62.0	1.060156	2.0	0.986190	12.0	0.919900	2.0	0.771500	13.0	0.682046







[illegible]





STATE I

P(1)

P(2)

STATE II

P(1)

P(2)

STATE III

P(1)

P(2)

STATE IV

P(1)

P(2)

STATE V

P(1)

P(2)

STATE VI

P(1)

P(2)

STATE VII

P(1)

P(2)

STATE VIII

P(1)

P(2)

STATE IX

P(1)

P(2)

STATE X

P(1)

P(2)

BPM=10

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56.531127-02

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1.510505

0.813887

7.166224-10

1.001300

1.634100-03

0.300045

15.261955-12

0.997609

1.641507-04

0.001307

60.471488-02

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2.541843-32

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0.000280

60.951680-02

0.888188

3.195564-01

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9.756260-07

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3.768000-07

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16.498004-07

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8.498004-07

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61.010165-02

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4.713000-01

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10.403112-22

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4.718610-01

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9.416117-01

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0.001037

61.359747-02

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6.161374-01

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20.121337-01

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0.000013

61.314667-02

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7.794668

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21.156162-04

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7.266568-01

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70.300000-02

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8.794668-01

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7.718617-04

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8.943537-21

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23.135274-04

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8.126577-01

0.001274

70.201274-02

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0.988765

8.189567-04

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9.154669-01

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24.136679-04

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9.388152-01

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50.166426-02

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0.776478

9.214085-08

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25.128468-02

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10.381319-01

0.191880

50.131689-02

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11.797353

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[illegible]

## D/M/10 COF OF WAITING TIME IN THE QUEUE

	T	P (0 ≤ T < 1)	T	P (0 ≤ T < 1)	T	P (0 ≤ T < 1)	T	P (0 ≤ T < 1)	T	P (0 ≤ T < 1)	T	P (0 ≤ T < 1)	T	P (0 ≤ T < 1)	T	P (0 ≤ T < 1)	
BRO= .10																	
0.0	1.000000		0.0	0.906162	2.1	0.999956	0.0	0.607026	3.0	0.970606	0.0	0.111163	22.0	0.635782			
BRO= .20																	
0.0	1.000000		0.0	0.907357	2.2	0.999955	0.1	0.606020	3.5	0.906950	0.1	0.110759	20.0	0.646876			
BRO= .30																	
0.0	1.000000		0.0	0.908215	2.3	0.999954	0.2	0.605030	4.0	0.807630	0.2	0.110359	18.0	0.658129			
BRO= .40																	
0.0	1.000000		0.0	0.909131	2.5	0.999950	0.3	0.604075	5.0	0.691562	0.3	0.121908	30.0	0.726612			
BRO= .50																	
0.0	1.000000		0.0	0.909750	2.6	0.999937	0.4	0.603140	6.0	0.625277	0.4	0.120999	32.0	0.757128			
BRO= .60																	
0.0	1.000000		0.0	0.910119	2.7	0.999919	0.5	0.602215	7.0	0.604812	0.5	0.132521	33.0	0.787612			
BRO= .70																	
0.0	0.999982	1.1	0.999995	1.2	0.908312	4.5	0.999963	0.7	0.702098	4.0	0.975699	0.7	0.136033	36.0	0.809570		
0.1	0.999954	1.2	0.999996	1.3	0.908215	4.6	0.999962	0.8	0.701072	5.0	0.928065	0.8	0.135299	38.0	0.809570		
0.2	0.999963	1.3	0.999997	1.4	0.909303	6.0	0.999968	0.9	0.730905	10.0	0.807549	0.9	0.140310	40.0	0.809570		
0.3	0.999970	1.4	0.999997	1.5	0.911167	7.0	0.999968	1.0	0.747647	15.0	0.718647	1.0	0.149331	44.0	0.809570		
0.4	0.999976	1.5	0.999998	1.6	0.911455	8.0	0.999980	1.1	0.755324	12.0	0.938320	1.1	0.149331	44.0	0.809570		
0.5	0.999981	1.6	0.999998	1.7	0.912617	9.0	0.999982	1.2	0.763950	13.0	0.956333	1.2	0.153731	46.0	0.809570		
0.6	0.999985	1.7	0.999999	1.8	0.913225	10.0	0.999977	1.3	0.771711	16.0	0.906731	1.3	0.156796	48.0	0.809570		
0.7	0.999988	1.8	0.999999	1.9	0.913920	11.0	0.999999	1.4	0.780477	16.0	0.938235	1.4	0.160696	50.0	0.809570		
0.8	0.999990	1.9	0.999999	2.0	0.914662			1.5	0.789243	17.0	0.908001	1.5	0.164990	52.0	0.809570		
0.9	0.999992	2.0	0.999999					1.6	0.798009	18.0	0.939162	1.6	0.169284	54.0	0.809570		
1.0	0.999994	2.1	0.999999					1.7	0.806775	19.0	0.907657	1.7	0.173579	56.0	0.809570		
BRO= .80																	
0.0	0.999381	1.8	0.999996	0.0	0.927009	2.3	0.907333	1.9	0.813206	20.0	0.999540	1.9	0.177660	75.0	0.809570		
0.1	0.999586	1.9	0.999999	0.1	0.912364	2.4	0.908261	2.0	0.812048	20.0	0.999540	2.0	0.180700	80.0	0.809570		
0.2	0.999796	2.0	0.999999	0.2	0.917320	2.5	0.909122	2.1	0.810905	20.0	0.999540	2.1	0.183740	85.0	0.809570		
0.3	0.999972	2.1	0.999999	0.3	0.922275	2.6	0.910000	2.2	0.809762	20.0	0.999540	2.2	0.186780	90.0	0.809570		
0.4	0.999992	2.2	0.999999	0.4	0.927230	2.7	0.910877	2.3	0.808619	20.0	0.999540	2.3	0.189820	95.0	0.809570		
0.5	0.999995	2.3	0.999999	0.5	0.932185	2.8	0.911752	2.4	0.807476	20.0	0.999540	2.4	0.192860	100.0	0.809570		
0.6	0.999996	2.4	0.999999	0.6	0.937140	2.9	0.912627	2.5	0.806333	20.0	0.999540	2.5	0.195900	105.0	0.809570		
0.7	0.999996	2.5	0.999999	0.7	0.942095	3.0	0.913502	2.6	0.805190	20.0	0.999540	2.6	0.198940	110.0	0.809570		
0.8	0.999996	2.6	0.999999	0.8	0.947050	3.1	0.914377	2.7	0.804047	20.0	0.999540	2.7	0.201980	115.0	0.809570		
0.9	0.999996	2.7	0.999999	0.9	0.952005	3.2	0.915252	2.8	0.802904	20.0	0.999540	2.8	0.205020	120.0	0.809570		
1.0	0.999996	2.8	0.999999	1.0	0.956960	3.3	0.916127	2.9	0.801761	20.0	0.999540	2.9	0.208060	125.0	0.809570		
1.1	0.999996	2.9	0.999999	1.1	0.961915	3.4	0.917002	3.0	0.800618	20.0	0.999540	3.0	0.211100	130.0	0.809570		
1.2	0.999996	3.0	0.999999	1.2	0.966870	3.5	0.917877	3.1	0.799475	20.0	0.999540	3.1	0.214140	135.0	0.809570		
1.3	0.999996	3.1	0.999999	1.3	0.971825	3.6	0.918752	3.2	0.798332	20.0	0.999540	3.2	0.217180	140.0	0.809570		
1.4	0.999996	3.2	0.999999	1.4	0.976780	3.7	0.919627	3.3	0.797189	20.0	0.999540	3.3	0.220220	145.0	0.809570		
1.5	0.999996	3.3	0.999999	1.5	0.981735	3.8	0.920502	3.4	0.796046	20.0	0.999540	3.4	0.223260	150.0	0.809570		
1.6	0.999996	3.4	0.999999	1.6	0.986690	3.9	0.921377	3.5	0.794903	20.0	0.999540	3.5	0.226300	155.0	0.809570		
1.7	0.999996	3.5	0.999999	1.7	0.991645	4.0	0.922252	3.6	0.793760	20.0	0.999540	3.6	0.229340	160.0	0.809570		
BRO= .90																	
0.0	0.999378	1.8	0.999996	0.0	0.986646	4.1	0.923127	3.7	0.792617	20.0	0.999540	3.7	0.232380	165.0	0.809570		
0.1	0.999585	1.9	0.999999	0.1	0.991601	4.2	0.924002	3.8	0.791474	20.0	0.999540	3.8	0.235420	170.0	0.809570		
0.2	0.999793	2.0	0.999999	0.2	0.996556	4.3	0.924877	3.9	0.790331	20.0	0.999540	3.9	0.238460	175.0	0.809570		
0.3	0.999963	2.1	0.999999	0.3	0.999511	4.4	0.925752	4.0	0.789188	20.0	0.999540	4.0	0.241500	180.0	0.809570		
0.4	0.999976	2.2	0.999999	0.4	0.999511	4.5	0.926627	4.1	0.788045	20.0	0.999540	4.1	0.244540	185.0	0.809570		
0.5	0.999992	2.3	0.999999	0.5	0.999511	4.6	0.927502	4.2	0.786902	20.0	0.999540	4.2	0.247580	190.0	0.809570		
0.6	0.999996	2.4	0.999999	0.6	0.999511	4.7	0.928377	4.3	0.785759	20.0	0.999540	4.3	0.250620	195.0	0.809570		
0.7	0.999996	2.5	0.999999	0.7	0.999511	4.8	0.929252	4.4	0.784616	20.0	0.999540	4.4	0.253660	200.0	0.809570		
0.8	0.999996	2.6	0.999999	0.8	0.999511	4.9	0.930127	4.5	0.783473	20.0	0.999540	4.5	0.256700	205.0	0.809570		
0.9	0.999996	2.7	0.999999	0.9	0.999511	5.0	0.931002	4.6	0.782330	20.0	0.999540	4.6	0.259740	210.0	0.809570		
1.0	0.999996	2.8	0.999999	1.0	0.999511	5.1	0.931877	4.7	0.781187	20.0	0.999540	4.7	0.262780	215.0	0.809570		
1.1	0.999996	2.9	0.999999	1.1	0.999511	5.2	0.932752	4.8	0.780044	20.0	0.999540	4.8	0.265820	220.0	0.809570		
1.2	0.999996	3.0	0.999999	1.2	0.999511	5.3	0.933627	4.9	0.778901	20.0	0.999540	4.9	0.268860	225.0	0.809570		
1.3	0.999996	3.1	0.999999	1.3	0.999511	5.4	0.934502	5.0	0.777758	20.0	0.999540	5.0	0.271900	230.0	0.809570		
1.4	0.999996	3.2	0.999999	1.4	0.999511	5.5	0.935377	5.1	0.776615	20.0	0.999540	5.1	0.274940	235.0	0.809570		
1.5	0.999996	3.3	0.999999	1.5	0.999511	5.6	0.936252	5.2	0.775472	20.0	0.999540	5.2	0.277980	240.0	0.809570		
1.6	0.999996	3.4	0.999999	1.6	0.999511	5.7	0.937127	5.3	0.774329	20.0	0.999540	5.3	0.281020	245.0	0.809570		
1.7	0.999996	3.5	0.999999	1.7	0.999511	5.8	0.938002	5.4	0.773186	20.0	0.999540	5.4	0.284060	250.0	0.809570		
BRO= .95																	
0.0	0.999378	2.0	0.999996	0.0	0.986646	4.2	0.923127	3.8	0.791474	20.0	0.999540	4.0	0.241500	185.0	0.809570		
0.1	0.999585	2.1	0.999999	0.1	0.991601	4.3	0.924002	3.9	0.790331	20.0	0.999540	4.1	0.244540	190.0	0.809570		
0.2	0.999793	2.2	0.999999	0.2	0.996556	4.4	0.924877	4.0	0.789188	20.0	0.999540	4.2	0.247580	195.0	0.809570		
0.3	0.999963	2.3	0.999999	0.3	0.999511	4.5	0.925752	4.1	0.788045	20.0	0.999540	4.3	0.250620	200.0	0.809570		
0.4	0.999976	2.4	0.999999	0.4	0.999511	4.6	0.926627	4.2	0.786902	20.0	0.999540	4.4	0.253660	205.0	0.809570		
0.5	0.999992	2.5	0.999999	0.5	0.999511	4.7	0.927502	4.3	0.785759	20.0	0.999540	4.5	0.256700	210.0	0.809570		
0.6	0.999996	2.6	0.999999	0.6	0.999511	4.8	0.928377	4.4	0.784616	20.0	0.999540	4.6	0.259740	215.0	0.809570		
0.7	0.999996	2.7	0.999999	0.7	0.999511	4.9	0.929252	4.5	0.783473	20.0	0.999540	4.7	0.262780	220.0	0.809570		
0.8	0.999996	2.8	0.999999	0.8	0.999511	5.0	0.930127	4.6	0.782330	20.0	0.999540	4.8	0.265820	225.0	0.809570		
0.9	0.999996	2.9	0.999999	0.9	0.999511	5.1	0.931002	4.7	0.781187	20.0	0.999540	4.9	0.268860	230.0	0.809570		
1.0	0.999996	3.0	0.999999	1.0	0.999511	5.2											

[illegible]

TIME		TIME		TIME		TIME		TIME		TIME		TIME		TIME		TIME		TIME	
T	P (UTC+7)	T	P (UTC+7)	T	P (UTC+7)	T	P (UTC+7)	T	P (UTC+7)	T	P (UTC+7)	T	P (UTC+7)	T	P (UTC+7)	T	P (UTC+7)	T	P (UTC+7)
RHO= .10		RHO= .65		RHO= .65		RHO= .65		RHO= .90		RHO= .90		RHO= .90		RHO= .90		RHO= .90		RHO= .90	
0.0	1.000000	0.0	0.987632	2.0	0.990056	0.0	0.792910	3.0	0.900722	0.0	0.553580	5.0	0.872399	0.0	0.987632	2.0	0.990056	0.0	0.792910
0.1	0.999999	0.1	0.988552	2.1	0.989831	0.1	0.790453	3.1	0.900051	0.1	0.551605	5.1	0.870843	0.1	0.986085	2.1	0.989831	0.1	0.790453
0.2	0.999999	0.2	0.989822	2.2	0.989127	0.2	0.787996	3.2	0.899379	0.2	0.549630	5.2	0.869294	0.2	0.984538	2.2	0.989127	0.2	0.787996
0.3	0.999999	0.3	0.990502	2.3	0.988332	0.3	0.785540	3.3	0.898708	0.3	0.547655	5.3	0.867745	0.3	0.983001	2.3	0.988332	0.3	0.785540
0.4	0.999999	0.4	0.991309	2.4	0.986863	0.4	0.783085	3.4	0.898027	0.4	0.545680	5.4	0.866196	0.4	0.981458	2.4	0.986863	0.4	0.783085
0.5	0.999999	0.5	0.992120	2.5	0.985982	0.5	0.780630	3.5	0.897346	0.5	0.543705	5.5	0.864747	0.5	0.979915	2.5	0.985982	0.5	0.780630
0.6	0.999999	0.6	0.992822	2.6	0.985085	0.6	0.778175	3.6	0.896665	0.6	0.541730	5.6	0.863298	0.6	0.978376	2.6	0.985085	0.6	0.778175
0.7	0.999999	0.7	0.993626	2.7	0.984188	0.7	0.775720	3.7	0.895984	0.7	0.539755	5.7	0.861849	0.7	0.976847	2.7	0.984188	0.7	0.775720
0.8	0.999999	0.8	0.994430	2.8	0.983290	0.8	0.773265	3.8	0.895303	0.8	0.537780	5.8	0.860400	0.8	0.975318	2.8	0.983290	0.8	0.773265
0.9	0.999999	0.9	0.995233	2.9	0.982393	0.9	0.770810	3.9	0.894622	0.9	0.535805	5.9	0.858951	0.9	0.973789	2.9	0.982393	0.9	0.770810
1.0	0.999999	1.0	0.996036	3.0	0.981495	1.0	0.768355	4.0	0.893941	1.0	0.533830	6.0	0.857502	1.0	0.972260	3.0	0.981495	1.0	0.768355
1.1	0.999999	1.1	0.996839	3.1	0.980596	1.1	0.765900	4.1	0.893260	1.1	0.531855	6.1	0.856053	1.1	0.970731	3.1	0.980596	1.1	0.765900
1.2	0.999999	1.2	0.997642	3.2	0.979697	1.2	0.763445	4.2	0.892579	1.2	0.529880	6.2	0.854604	1.2	0.969202	3.2	0.979697	1.2	0.763445
1.3	0.999999	1.3	0.998445	3.3	0.978798	1.3	0.760990	4.3	0.891898	1.3	0.527905	6.3	0.853155	1.3	0.967673	3.3	0.978798	1.3	0.760990
1.4	0.999999	1.4	0.999248	3.4	0.977899	1.4	0.758535	4.4	0.891217	1.4	0.525930	6.4	0.851706	1.4	0.966144	3.4	0.977899	1.4	0.758535
1.5	0.999999	1.5	0.999999	3.5	0.977000	1.5	0.756080	4.5	0.890536	1.5	0.523955	6.5	0.850257	1.5	0.964615	3.5	0.977000	1.5	0.756080
1.6	0.999999	1.6	0.999999	3.6	0.976201	1.6	0.753625	4.6	0.889855	1.6	0.521980	6.6	0.848808	1.6	0.963086	3.6	0.976201	1.6	0.753625
1.7	0.999999	1.7	0.999999	3.7	0.975402	1.7	0.751170	4.7	0.889174	1.7	0.520005	6.7	0.847360	1.7	0.961557	3.7	0.975402	1.7	0.751170
1.8	0.999999	1.8	0.999999	3.8	0.974603	1.8	0.748715	4.8	0.888493	1.8	0.518030	6.8	0.845911	1.8	0.959999	3.8	0.974603	1.8	0.748715
1.9	0.999999	1.9	0.999999	3.9	0.973804	1.9	0.746260	4.9	0.887812	1.9	0.516055	6.9	0.844462	1.9	0.958550	3.9	0.973804	1.9	0.746260
2.0	0.999999	2.0	0.999999	4.0	0.973005	2.0	0.743805	5.0	0.887131	2.0	0.514080	7.0	0.843013	2.0	0.957101	4.0	0.973005	2.0	0.743805
2.1	0.999999	2.1	0.999999	4.1	0.972206	2.1	0.741350	5.1	0.886450	2.1	0.512105	7.1	0.841564	2.1	0.955652	4.1	0.972206	2.1	0.741350
2.2	0.999999	2.2	0.999999	4.2	0.971407	2.2	0.738895	5.2	0.885769	2.2	0.510130	7.2	0.840115	2.2	0.954203	4.2	0.971407	2.2	0.738895
2.3	0.999999	2.3	0.999999	4.3	0.970608	2.3	0.736440	5.3	0.885088	2.3	0.508155	7.3	0.838666	2.3	0.952754	4.3	0.970608	2.3	0.736440
2.4	0.999999	2.4	0.999999	4.4	0.969809	2.4	0.733985	5.4	0.884407	2.4	0.506180	7.4	0.837217	2.4	0.951305	4.4	0.969809	2.4	0.733985
2.5	0.999999	2.5	0.999999	4.5	0.969010	2.5	0.731530	5.5	0.883726	2.5	0.504205	7.5	0.835768	2.5	0.949856	4.5	0.969010	2.5	0.731530
2.6	0.999999	2.6	0.999999	4.6	0.968211	2.6	0.729075	5.6	0.883045	2.6	0.502230	7.6	0.834319	2.6	0.948407	4.6	0.968211	2.6	0.729075
2.7	0.999999	2.7	0.999999	4.7	0.967412	2.7	0.726620	5.7	0.882364	2.7	0.500255	7.7	0.832870	2.7	0.946958	4.7	0.967412	2.7	0.726620
2.8	0.999999	2.8	0.999999	4.8	0.966613	2.8	0.724165	5.8	0.881683	2.8	0.498280	7.8	0.831421	2.8	0.945509	4.8	0.966613	2.8	0.724165
2.9	0.999999	2.9	0.999999	4.9	0.965814	2.9	0.721710	5.9	0.881002	2.9	0.496305	7.9	0.830000	2.9	0.944060	4.9	0.965814	2.9	0.721710
3.0	0.999999	3.0	0.999999	5.0	0.965015	3.0	0.719255	6.0	0.880321	3.0	0.494330	8.0	0.828551	3.0	0.942611	5.0	0.965015	3.0	0.719255
3.1	0.999999	3.1	0.999999	5.1	0.964216	3.1	0.716800	6.1	0.879640	3.1	0.492355	8.1	0.827102	3.1	0.941162	5.1	0.964216	3.1	0.716800
3.2	0.999999	3.2	0.999999	5.2	0.963417	3.2	0.714345	6.2	0.878959	3.2	0.490380	8.2	0.825653	3.2	0.939713	5.2	0.963417	3.2	0.714345
3.3	0.999999	3.3	0.999999	5.3	0.962618	3.3	0.711890	6.3	0.878278	3.3	0.488405	8.3	0.824204	3.3	0.938264	5.3	0.962618	3.3	0.711890
3.4	0.999999	3.4	0.999999	5.4	0.961819	3.4	0.709435	6.4	0.877597	3.4	0.486430	8.4	0.822755	3.4	0.936815	5.4	0.961819	3.4	0.709435
3.5	0.999999	3.5	0.999999	5.5	0.961020	3.5	0.706980	6.5	0.876916	3.5	0.484455	8.5	0.821306	3.5	0.935366	5.5	0.961020	3.5	0.706980
3.6	0.999999	3.6	0.999999	5.6	0.960221	3.6	0.704525	6.6	0.876235	3.6	0.482480	8.6	0.819857	3.6	0.933917	5.6	0.960221	3.6	0.704525
3.7	0.999999	3.7	0.999999	5.7	0.959422	3.7	0.702070	6.7	0.875554	3.7	0.480505	8.7	0.818408	3.7	0.932468	5.7	0.959422	3.7	0.702070
3.8	0.999999	3.8	0.999999	5.8	0.958623	3.8	0.699625	6.8	0.874873	3.8	0.478530	8.8	0.816959	3.8	0.931019	5.8	0.958623	3.8	0.699625
3.9	0.999999	3.9	0.999999	5.9	0.957824	3.9	0.697170	6.9	0.874192	3.9	0.476555	8.9	0.815510	3.9	0.929570	5.9	0.957824	3.9	0.697170
4.0	0.999999	4.0	0.999999	6.0	0.957025	4.0	0.694715	7.0	0.873511	4.0	0.474580	9.0	0.814061	4.0	0.928121	6.0	0.957025	4.0	0.694715
4.1	0.999999	4.1	0.999999	6.1	0.956226	4.1	0.692260	7.1	0.872830	4.1	0.472605	9.1	0.812612	4.1	0.926672	6.1	0.956226	4.1	0.692260
4.2	0.999999	4.2	0.999999	6.2	0.955427	4.2	0.689805	7.2	0.872149	4.2	0.470630	9.2	0.811163	4.2	0.925223	6.2	0.955427	4.2	0.689805
4.3	0.999999	4.3	0.999999	6.3	0.954628	4.3	0.687350	7.3	0.871468	4.3	0.468655	9.3	0.809714	4.3	0.923774	6.3	0.954628	4.3	0.687350
4.4	0.999999	4.4	0.999999	6.4	0.953829	4.4	0.684895	7.4	0.870787	4.4	0.466680	9.4	0.808265	4.4	0.922325	6.4	0.953829	4.4	0.684895
4.5	0.999999	4.5	0.999999	6.5	0.953030	4.5	0.682440	7.5	0.870106	4.5	0.464705	9.5	0.806816	4.5	0.920876	6.5	0.953030	4.5	0.682440
4.6	0.999999	4.6	0.999999	6.6	0.952231	4.6	0.680085	7.6	0.869425	4.6	0.462730	9.6	0.805367	4.6	0.919427	6.6	0.952231	4.6	0.680085
4.7	0.999999	4.7	0.999999	6.7	0.951432	4.7	0.677630	7.7	0.868744	4.7	0.460755	9.7	0.803918	4.7	0.917978	6.7	0.951432	4.7	0.677630
4.8	0.999999	4.8	0.999999	6.8	0.950633	4.8	0.675175	7.8	0.868063	4.8	0.458780	9.8	0.802469	4.8	0.916529	6.8	0.950633	4.8	0.675175
4.9	0.999999	4.9	0.999999	6.9	0.949834	4.9	0.672720	7.9	0.867382	4.9	0.456805	9.9	0.801020	4.9	0.915080	6.9	0.949834	4.9	0.672720
5.0	0.999999	5.0	0.999999	7.0	0.949035	5.0	0.670265	8.0	0.866701	5.0	0.454830	10.0	0.799571	5.0	0.913631	7.0	0.949035	5.0	0.670265
5.1	0.999999	5.1	0.999999	7.1	0.948236	5.1	0.667810	8.1	0.866020	5.1	0.452855	10.1	0.798122	5.1	0.912182	7.1	0.948236	5.1	0.667810
5.2	0.999999	5.2	0.999999	7.2	0.947437	5.2	0.665355	8.2	0.865339	5.2	0.450880	10.2	0.796673	5.2	0.910733	7.2	0.947437	5.2	0.665355
5.3	0.999999	5.3	0.999999	7.3	0.946638	5.3	0.662900	8.3	0.864658	5.3	0.448905	10.3	0.795224	5.3	0.909284	7.3	0.946638	5.3	0.662900
5.4	0.999999	5.4	0.999999	7.4	0.945839	5.4	0.660445	8.4	0.863977	5.4	0.446930	10.4	0.793775	5.4	0.907835	7.4	0.945839	5.4	0.660445
5.5	0.999999	5.5	0.999999	7.5	0.945040	5.5	0.657990	8.5	0.863296	5.5	0.444955	10.5	0.792326	5.5	0.906386	7.5	0.945040	5.5	0.657990
5.6																			

Tables for the  $D/E_2/2$  Queueing System

The Model: Individual customers arrive at constant intervals;  
service times have an Erlang distribution with the  
shape parameter equal to 2.  
2 servers operate in parallel.

Notation: See Section 1.2.

Tables Included:  $L_q$ ,  $P(N = 1)$  and  $P(N \leq 1)$ ,  $P(WT \leq T)$ .



EXPECTED LENGTH OF QUEUE FOR  $D/E_2/2$ 

RHO	
0.10	0.00000
0.20	0.0000041003
0.30	0.00048981
0.40	0.0058345
0.50	0.028938
0.55	0.054288
0.60	0.094775
0.65	0.15727
0.70	0.25249
0.75	0.39888
0.80	0.63255
0.85	1.0370
0.90	1.8609
0.95	4.3578
0.98	11.858
0.99	24.357

[illegible]

D/E<sub>2</sub>/2 CDF OF WAITING TIME IN THE QUEUE

T	P(WT<T)	T	P(WT<T)	T	P(WT<T)	T	P(WT<T)	T	P(WT<T)	T	P(WT<T)
RHO=0.10				RHO=0.65				RHO=0.90			
0	0.999999	1	1.000000	0	0.806328	6	0.999832	0	0.293257	10	0.984689
RHO=0.20				1	0.934771	7	0.999950	1	0.508228	11	0.989594
0	0.999980	2	0.999999	2	0.979470	8	0.999985	2	0.664083	12	0.992928
1	0.999996	3	0.999999	3	0.993734	9	0.999996	3	0.771459	13	0.995193
RHO=0.30				4	0.998115	10	0.999999	4	0.844642	14	0.996733
0	0.998418	3	0.999990	5	0.999437	11	1.000000	5	0.894409	15	0.997780
1	0.999697	4	0.999998	RHO=0.70				6	0.928236	16	0.998491
2	0.999945	5	0.999999	0	0.732038	7	0.999818	7	0.951227	17	0.998975
RHO=0.40				1	0.897958	8	0.999937	8	0.966852	18	0.999303
0	0.986204	4	0.999978	2	0.963402	9	0.999978	9	0.977471	19	0.999526
1	0.997037	5	0.999995	3	0.987186	10	0.999993	RHO=0.95			
2	0.999404	6	0.999999	4	0.995557	11	0.999997	0	0.151783	10	0.879705
3	0.999885	7	1.000000	5	0.998465	12	0.999999	1	0.295737	11	0.901176
RHO=0.50				6	0.999471	13	1.000000	2	0.420343	12	0.918815
0	0.947422	4	0.999855	RHO=0.75				3	0.523650	13	0.933306
1	0.986891	5	0.999969	0	0.643222	8	0.999720	4	0.608651	14	0.945210
2	0.996970	6	0.999993	1	0.844619	9	0.999887	5	0.678500	15	0.954989
3	0.999330	7	0.999999	2	0.935653	10	0.999955	6	0.735884	16	0.963023
RHO=0.55				3	0.973819	11	0.999982	7	0.783026	17	0.969623
0	0.913026	5	0.999919	4	0.989413	12	0.999993	8	0.821753	18	0.975045
1	0.976290	6	0.999981	5	0.995728	13	0.999997	9	0.853568	19	0.979499
2	0.994010	7	0.999996	6	0.998278	14	0.999999	RHO=0.98			
3	0.998549	8	0.999999	7	0.999306	15	1.000000	0	0.061863	10	0.574187
4	0.999657	9	1.000000	RHO=0.80				1	0.130062	11	0.606714
RHO=0.60				0	0.540039	10	0.999703	2	0.196006	12	0.636756
0	0.866399	5	0.999789	1	0.768317	11	0.999859	3	0.257348	13	0.664504
1	0.959745	6	0.999945	2	0.887858	12	0.999933	4	0.314068	14	0.690132
2	0.988728	7	0.999986	3	0.946369	13	0.999968	5	0.366464	15	0.713802
3	0.996959	8	0.999996	4	0.974443	14	0.999985	6	0.414859	16	0.735664
4	0.999195	9	0.999999	5	0.987835	15	0.999993	7	0.459557	17	0.755856
				6	0.994211	16	0.999997	8	0.500840	18	0.774506
				7	0.997245	17	0.999998	9	0.538970	19	0.791731
				8	0.998689	18	0.999999	RHO=0.99			
				9	0.999376	19	1.000000	0	0.031119	10	0.348174
				RHO=0.85				1	0.067167	11	0.373649
				0	0.423072	10	0.997933	2	0.103357	12	0.398128
				1	0.660222	11	0.998829	3	0.138361	13	0.421650
				2	0.805613	12	0.999337	4	0.172030	14	0.444254
				3	0.889617	13	0.999624	5	0.204389	15	0.465973
				4	0.937437	14	0.999787	6	0.235483	16	0.486844
				5	0.964556	15	0.999879	7	0.265362	17	0.506900
				6	0.979922	16	0.999932	8	0.294074	18	0.526171
				7	0.988627	17	0.999961	9	0.321663	19	0.544689
				8	0.993558	18	0.999978				
				9	0.996351	19	0.999988				

Tables for the  $M/E_2/2$  Queueing System

The Model: Customers arrive randomly, i.e., according to a Poisson process  
(exponential distribution of interarrival times);  
service times have an Erlang distribution with the shape  
parameter equal to 2;  
2 servers operate in parallel.

Notation: See Section 1.2.

Tables Included:  $L_q$ ,  $P(N = 1)$  and  $P(N \leq 1)$ ,  $P(WT \leq T)$ .

EXPECTED LENGTH OF QUEUE FOR  $M/E_2/2$ 

RHO	
0.10	0.0016136
0.20	0.013134
0.30	0.046254
0.40	0.11772
0.50	0.25564
0.55	0.36470
0.60	0.51451
0.65	0.72305
0.70	1.0200
0.75	1.4593
0.80	2.1478
0.85	3.3358
0.90	5.7732
0.95	13.210
0.98	35.672
0.99	73.159

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TECHNICAL REPORT NO. 90

This report provides a relatively comprehensive set of tables describing the steady-state behavior of M/M/c, M/D/c, and D/M/c queueing systems. The results given are the probability distribution of the number of customers in the system (including those being served) and of the waiting time of individual customers in the queue (excluding service time), as well as the expected number of customers in the queue (excluding those being served). The cases considered are  $c = 1, 2, \dots, 10$  and  $c = 15$  for all three classes of queueing systems, plus  $c = 12$  for M/D/c and  $c = 20, 25$  for M/M/c. For each case, the results are tabulated for 16 values of the traffic intensity ranging from 0.10 to 0.99. Also included for comparative purposes are the corresponding results for two related cases,  $D/D_2/2$  and  $M/E_2/2$ . These data represent one portion of the output from a large-scale project of theoretical research, algorithmic development, and computational effort to generate the obtainable numerical results for various classes of GI/G/c systems.

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